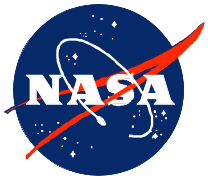


National Aeronautics and Space Administration

Volume 4, NASA Enterprise Architecture: Strategies and Structure

Version # 3.0
August 25, 2004

NASA Enterprise Architecture
Structure and Strategies

Table of Changes

Date of Change	Section(s) Affected	Brief Description of Change	Change Made By	Organization
December 22, 2003	Initial Version	Final Version 2.1	Chief Technology Officer, Code AO	NASA Office of the CIO
March 26, 2004	Minor editorial updates	Final Version 2.2	Chief Technology Officer, Code AO	NASA Office of the CIO
July 2, 2004	Minor editorial updates	Final Version 2.3	Chief Technology Officer, Office of the CIO	NASA Office of the CIO
August 25, 2004	Update of portfolio structure, summary OAIT and program summaries, and add transition processes	Final Version 3.0	EA Core Team	NASA Office of the CIO
August 25, 2004	Formatting	Vol 4	Tressa Reaggle	EA Core Team

Table of Acronyms

BAS	Basic Accounting System
CIO	Chief Information Officer
COAD	Commitment, Obligation, Accrual, Disbursement
DARTS	Dryden Accounting and Resources Tracking
EA	Enterprise Architecture
EAI	Enterprise Applications Integration
FACS	Financial and Contractual Status
FAS	Financial Accounting System
FAS/T	Financial Accounting System
FEAF	Federal Enterprise Architecture Framework
FMS	Financial Management System
IBAS	Interactive Basic Accounting System
IFMP	Integrated Financial Management Program
MARTS	Marshall Accounting and Resource Tracking System
NISSU	NASA's Information System Services Utility
ODIN	Outsourcing Desktop Initiative for NASA
OPAC	Online Payment and Collection
STARS	Staffing and Recruiting Systems
TCO	Total Cost of Ownership
TRM	Technical Reference Model
VPN	Virtual Private Network

DOCUMENT OUTLINE

Table of Contents

Figure References

Table References

1 Executive Overview

Enterprise Architecture is a tool that links the mission and strategy of an organization to its IT strategy. When complemented by strong governance processes Enterprise Architecture can effectively guide the IT capital investment and planning processes and help an organization optimize the return on its IT investments. This optimization is achieved by identifying and defining common processes and functions, common information needs of different users, technology standards, and reusable common services that can be leveraged by multiple systems within the organization.

A strong Enterprise Architecture facilitates the introduction and adoption of new technologies into an organization by separating an organization's processes and services, the "what", from the technologies, the "how" that support them. This separation allows the technologies, which evolve at a faster rate, to be changed independently from the process or service requirements, which usually evolve at a slower rate. The separation simplifies the introduction of new technologies into an organization.

The "Clinger-Cohen Act of 1996" requires each federal agency to develop an enterprise information technology architecture. To facilitate the consistent development of enterprise architectures across federal agencies the Federal Chief Information Officer (CIO) Council developed and published the Federal Enterprise Architecture and the supporting reference models.

NASA's architectural development is an iterative and continuous process. The Agency is fully committed to working with the Office of Management and Budget (OMB), the General Accounting Office (GAO), and other entities within the Federal Government to identify opportunities to collaborate, consolidate, and leverage investments to reach the goal of overall government improvement. The NASA Enterprise Architecture is based on the Federal Enterprise Architecture and the associated supporting reference models. NASA has extended the Federal framework and reference models, where appropriate, utilizing commercial best practices.

This version of NASA Enterprise Architecture documents the complete Agency Enterprise Architecture, including the Infrastructure, Office Automation and Telecommunications segment, a representative set of elements from the Mission Specific IT segment and the Financial Architectural Segment. NASA has determined that in order to continue to meet its mission effectively and efficiently, and to facilitate better program, project and information technology decision-making, it is important to make develop, communicate and manage a consistent agency-wide Enterprise Architecture.

NASA has embarked upon a major Information Technology program, the Integrated Information Infrastructure Program, to support the transition from the current "as-is" stated to the desired "to-be" state. The information technology segments documented here identify the current state of the NASA information technology environment and define the target state in terms of business, information, application, and technology architecture. In addition, it outlines the transition plan

for each segment from the current state to the target state. This document will be updated to incorporate changes in implementation strategy and/or tactics.

2 Introduction

The NASA Enterprise Architecture (EA) focuses on leveraging the Agency's investment in legacy systems and driving the design on our emerging systems. The Enterprise Architecture leverages existing systems that NASA has in place, built separately by Centers and Programs over several decades. The NASA Enterprise Architecture and the associate reference models mold those systems into an integrated or federated infrastructure aligned with the Agency's mission and business needs. The model for the "to-be" state is based on a service-oriented architecture that allows for services provided by any of the following approaches:

- Locally managed and provisioned services
- Centrally managed and locally provisioned services
- Centrally managed and provisioned services

The NASA Enterprise Architecture provides a mission driven approach to designing and implementing, partnering, or procuring new information technology systems and services. The true value of Enterprise Architecture is achieved when the architecture increases NASA's ability to deliver on our core missions. The NASA information technology systems and the Enterprise Architecture exist to support the vision presented in the NASA Strategic Plan and the three core missions and ten major goals of the Agency.

3 The Federal Enterprise Architecture

The NASA Enterprise Architecture must be consistent with the Federal Enterprise Architecture. It must support the Agency's strategic enterprises and allow NASA to provide services across the diverse citizens business areas, support the delivery of the services, and support NASA's internal operations and infrastructure.

The Office of Management and Budget (OMB) is developing the Federal Enterprise Architecture (FEA), a business-based framework for Government-wide improvement. The FEA is being constructed through a collection of interrelated "reference models" designed to facilitate cross-agency analysis and the identification of duplicative investments, gaps, and opportunities for collaboration within and across Federal Agencies. These models are defined as:

- Performance Reference Model (PRM)
- Business Reference Model (BRM)
- Service Component Reference Model (SRM)
- Data and Information Reference Model (DRM)
- Technical Reference Model (TRM)

Figure 1, Federal Enterprise Architecture (FEA)

3.1 Performance Reference Model (PRM)

The PRM is a framework for performance measurement that provides common application measures throughout the federal government. It allows agencies to better manage the business of Government at a federal strategic level while providing a means for gauging progress towards the target FEA. The PRM establishes a common set of general performance outputs and measures that agencies use to achieve much broader program and business goals and objectives.

The model articulates the linkage between internal business components and the achievement of business and customer-centric outcomes to align and leverage existing federal guidance and application/architecture recommendations. It facilitates resource allocation decisions based on comparative determinations of which programs/organizations are more efficient and effective. By defining outcome and output measures for lines of business and sub-functions, the PRM provides the tools necessary to measure cross-agency initiatives at the federal enterprise level.

3.2 Business Reference Model (BRM)

The Business Reference Model provides an organized, hierarchical construct for describing the day-to-day business operations of the Federal government. The Lines of Business and Sub-functions that comprise the BRM represent a departure from previous models of the Federal government that use antiquated, stove-piped, agency-oriented frameworks. The BRM is the first layer of the Federal Enterprise Architecture and it is the main viewpoint for the analysis of data, service components and technology.

The BRM identifies four Business Areas that provide a high-level view of the operations the Federal Government performs.

3.2.1 Services for Citizens

The Services for Citizens Business Area describes the mission and purpose of the United States government in terms of the services it provides both to and on behalf of the American citizen. It includes the delivery of citizen-focused, public, and collective goods and/or benefits as a service and/or obligation of the Federal Government to the benefit and protection of the nation's general population.

3.2.2 Mode of Delivery

The Mode of Delivery Business Area describes the mechanisms the government uses to achieve the purpose of government, or its Services to Citizens. It includes Financial Vehicles, Direct Government Delivery, and Indirect Government Delivery.

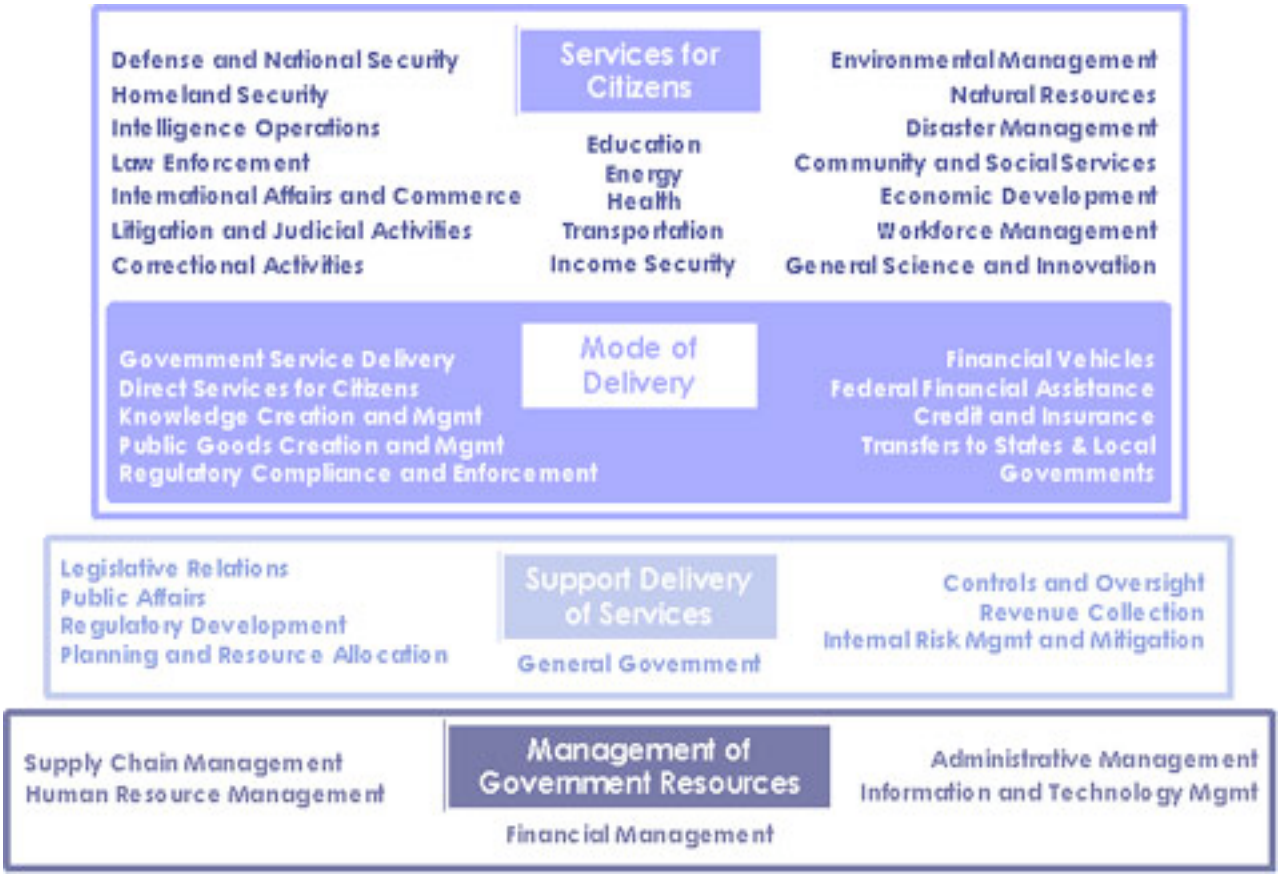
3.2.3 Support Delivery of Services

Support Delivery of Services provides the critical policy, programmatic and managerial Foundation to support federal government operations.

3.2.4 Management of Government Resources

Management of Government Resources refers to the back office support activities that enable the government to operate effectively.

Figure 2, FEA Business Reference Model (BRM)



NASA has adopted the FEA Business Reference Model as the basis for the Agency Business Reference Model. The BRM was used as a part of the FY'03 business case (Form 300) submission to OMB. All of the elements in the NASA submissions were mapped to the BRM. The NASA BRM is being evaluated for completeness and will be updated to add agency specific elements if required.
NASA's external services map to the following Services for Citizens business areas:

- Economic Development
  - Business / Industry Development
- Education
  - Education and Cultural Institutions
- Energy
  - Energy Resource Management
- Environmental Management
  - Environmental Monitoring and Forecasting
- General Science and Innovation
  - Scientific Innovation
  - Space Flight Innovation
  - Technological Innovation
- International Affairs
  - Foreign Affairs
- Workforce management
  - Training and Employment

3.3 Service Component Reference Model (SRM)

"The Service Component Reference Model (SRM) is a business and performance-driven, functional framework that classifies Service Components with respect to how they support business and/or performance objectives."[1]

The SRM is intended for use to support the discovery of government-wide business and application Service Components in IT investments and assets. The SRM is structured across horizontal and vertical service domains that, independent of the business functions, can provide a leverage-able foundation to support the reuse of applications, application capabilities, components, and business services.

3.3.1 Customer Services

The Customer Services Domain defines the set of capabilities that are directly related to an internal or external customer, the business' interaction with the customer, and the customer driven activities or functions. The Customer Services domain represents those capabilities and services that are at the front end of a business, and interface at varying levels with the customer.

[1] Federal Enterprise Architecture Program Office Web Site, www.feapmo.gov

3.3.2 Process Automation Services

The Process Automation Services Domain defines the set of capabilities that support the automation of process and management activities that assist in effectively managing the business. The Process Automation Services domain represents those services and capabilities that serve to automate and facilitate the processes associated with tracking, monitoring, maintaining liaison throughout the business cycle of an organization.

3.3.3 Business Management Services

The Business Management Services Domain defines the set of capabilities that support the management of business functions and organizational activities that maintain continuity across the business and value-chain participants. The Business Management Services domain represents those capabilities and services that are necessary for projects, programs and planning within a business operation to successfully be managed.

3.3.4 Digital Asset Services

The Digital Asset Services Domain defines the set of capabilities that support the generation, management and distribution of intellectual capital and electronic media across the business and extended enterprise.

3.3.5 Business Analytical Services

The Business Analytical Services Domain defines the set of capabilities supporting the extraction, aggregation and presentation of information to facilitate decision analysis and business evaluation.

3.3.6 Back Office Services

The Back Office Services Domain refers to the set of capabilities that support the management of enterprise planning transactional-based functions.

3.3.7 Support Services

The Support Services Domain defines the set of cross-functional capabilities that can be leveraged independent of Service Domain objective and / or mission.

Figure 3, FEA Service Component Reference Model (SRM)

NASA has adopted the FEA Service Component Reference Model as the basis for the Agency Service Component Reference Model. The SRM was used as a part of the FY'03 business case (Form 300) submission to OMB. All of the elements in the NASA submissions were mapped to the SRM. The NASA SRM is being evaluated for completeness and will be updated to add agency specific elements if required.

3.4Data and Information Reference Model (DRM)

The Data and Information Reference Model (DRM) will describe, at an aggregate level, the data and information that support program and business line operations. The model will aid in

describing the types of interaction and exchanges that occur between the Federal Government and its various customers, constituencies, and business partners.

The DRM will categorize the government's information along general content areas and decomposes those content areas into greater levels of detail. The DRM establishes a commonly understood classification for Federal data and leads to the identification of duplicative data resources. A common data model will streamline the processes associated with information exchange both within the Federal government between the government and its external stakeholders.

NASA is developing a Data and Information Reference Model. The NASA DRM will be updated to align with the FEA Data and Information Reference Model as required.

3.5Technical Reference Model (TRM)

"The TRM is a component-driven, technical framework used to identify the standards, specifications, and technologies that support and enable the delivery of service components and capabilities." [2]

The Technical Reference Model (TRM) provides a foundation to describe the standards, specifications, and technologies to support the construction, delivery, and exchange of business and application components (Service Components) that may be used and leveraged in a Component-Based or Service-Orientated Architecture. The TRM unifies existing Agency TRMs and electronic Government (e-Gov) guidance by providing a foundation to advance the re-use of technology and component services from a Government-wide perspective.

3.5.1 Service Access and Delivery Area

This refers to the collection standard and specifications to support external access, exchange, and delivery of Service Components or capabilities. This area also includes the Legislative and Regulator requirements governing the access and usage of the specific Service Component.

3.5.2 Service Platform and Infrastructure

The Service Platform and Infrastructure Area defines the collection of platforms, hardware and infrastructure specifications that enable Component-Based Architectures and Service Component re-use.

[2] Federal Enterprise Architecture Program Office Web Site, www.feapmo.gov

3.5.3 Component Framework

The Component Framework Area defines the underlying foundation and technical elements by which Service Components are built, integrated and deployed across Component-Based and Distributed Architectures. The Component Framework consists of the design of application or system software that incorporates interfaces for interacting with other programs and for future flexibility and expandability. This includes, but is not limited to, modules that are designed to interoperate with each other at runtime. Components can be large or small, written by different programmers using different development environments and may be platform independent. Components can be executed on stand-alone machines, a LAN, Intranet or on the Internet.

3.5.4 Service Interface and Integration

The Service Interface and Integration Area defines the discovery, interaction and communication technologies joining disparate systems and information providers. Component-based architectures leverage and incorporate Service Interface and Integration specifications to provide interoperability and scalability.

Figure 4, FEA Techical Reference Model (TRM)

NASA has adopted the FEA Technical Reference Model as the high-level structure for the Agency Technical Reference Model. The existing NASA Technical Standards documents form the detailed layers of the technical reference model. The TRM and associated technical standards define the basis for developing solutions that are consistent with the NASA "to-be" or future state. The NASA TRM was used as a part of the FY'03 business case (Form 300) submission to OMB. All of the elements in the NASA submissions were mapped to the TRM. The NASA TRM is being evaluated for completeness and will be updated to add agency specific elements if required.

4 NASA IT Strategy, Goals and Objectives

4.1 Internal Architectural Drivers

The Agency operating model now requires increased capability to work across centers, generating requirements that, by their nature, are best met at the agency level. The global shift in how information and knowledge is generated, used and managed, when coupled with the competition for limited budgets, dictates a more strategic approach to providing information infrastructure services across NASA. In addition to the various external drivers, there are a number of NASA-specific drivers for approaching IT systems more strategically. These include:

- OneNASA (Using IT as an integrating system and provider of common tools)
- Fixing and improving NASA's IT infrastructure to meet the NASA Vision and Strategic Plan
- Positioning the IT infrastructure to support Agency-wide applications such as Integrated Financial Management (IFM)
- Ensuring availability of integrated services across Centers
- Providing greater knowledge management and information sharing
- Supporting a robust collaborative program and management environment
- Achieving reduced cost of services to the customers (programs, projects, and General and Administrative users)
- Improving security
- And most importantly, delivering consistent and quality services to customers

As a consequence of these many influences and drivers, the NASA Integrated Information Infrastructure Program is a transformation strategy for:

- Managing the IT infrastructure as an integrated architecture
- Providing an infrastructure that can evolve and adapt to emerging technologies and service models
- Providing information tools and services that enhance programs and management
- Providing a customer focus to the provisioning of common IT services across NASA
- Enabling effective and efficient integration with Federal e-Government applications

The NASA Chief Information Officer is responsible for achieving these objectives and for ensuring that all Enterprises and offices throughout the Agency can take full advantage of the new and improved capabilities. Programs and projects, and the NASA institutions, need to know they can rely on the infrastructure services to be there when they need them, and where to surface new requirements so that the infrastructure can plan to meet those requirements. Our information technology strategy will enable NASA to not only fulfill its Mission but also to remain a leader in developing and deploying techniques for managing information and records.

4.2 The NASA Shared Services Center

In March 2002, the report of the NASA Consolidated Business Services Study Team was released, Consolidated Business Services: A New Opportunity for Better Services. NASA can improve business

services and save money by consolidating selected administrative support for NASA's primary aeronautics and space mission organizations (Centers) into a new Consolidated Business Service (CBS) entity. This new consolidation concept/vision also supports a "One NASA" Agency focus; provides consistent, high quality, "one face" services to internal partner Centers and employees and to external customers and stakeholders; and frees up Center resources to focus on core mission performance.

The new concept can provide more effective, efficient, and economical services than the current approach of providing support through multiple, small, non-standard, non-integrated, distributed administrative activities. A new shared services organization can improve quality and effectiveness, reduce costs, improve efficiency, and establish a framework for future improvements. NASA can provide high quality business transactional and specialty services to Centers and NASA Headquarters through a new shared services entity while retaining other required analytical and advisory services at Centers and at Headquarters. The new shared services initiative also supports The Presidents Management Agenda for improved government performance. Business consolidation supports more strategic management of human capital, improved resources management, greater focus on core mission performance, greater competitive sourcing, improved financial management, improved information systems, and future electronic government (e-gov) goals.

In August 2002, the Consolidated Business Services Implementation Team was formed under the leadership of James L. Jennings, NASA Associate Deputy Administrator for Institutions and Asset Management. The name of the implementation effort was soon changed to the NASA Shared Services Center (NSSC) to better represent the potential overall content of services to be provided. The NSSC Implementation Team focused on the following functional areas: Human Resources, Procurement, Financial Management, Resources Management, Information Technology, and Facilities. Both a location decision and contract for the NSSC are currently pending.

5 Enterprise Architecture Authority and Management Structure

The Institutional Committee and the Executive Council will serve as the Steering Committee for the Enterprise Architecture. The Associate Deputy Administrator for Institutions and Asset Management will determine the appropriate governing program management body (i.e., Program Management Council (PMC), Institutional Committee (IC), or Executive Council (EC), as appropriate.)

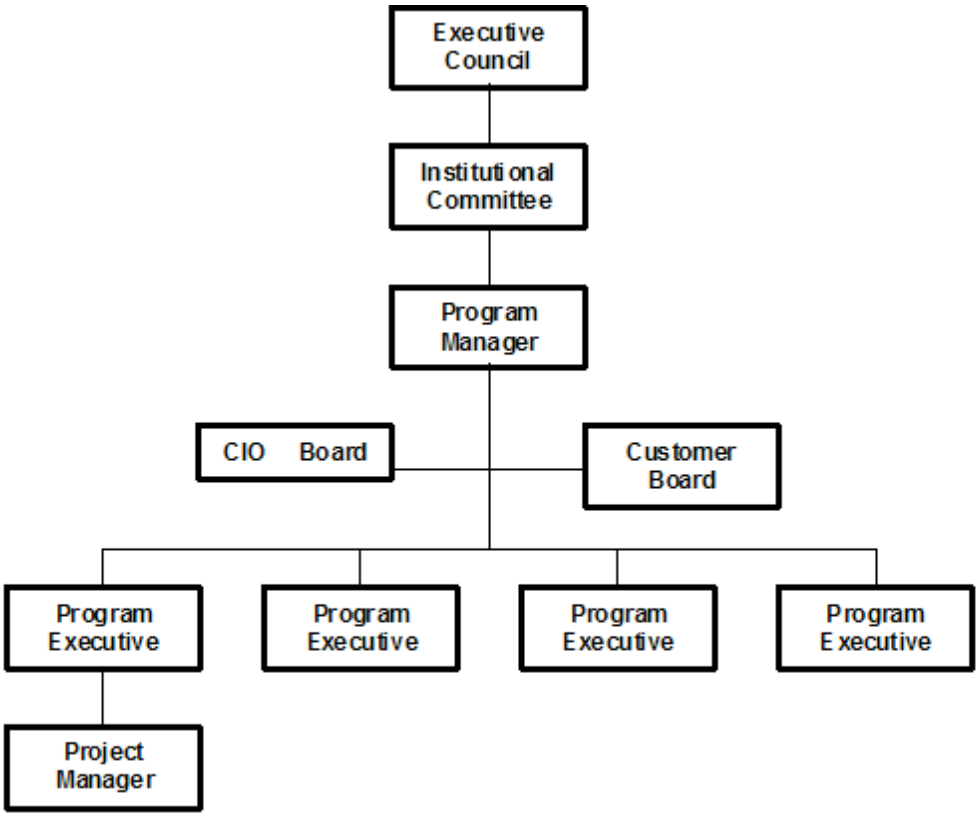
The NASA Chief Information Officer is responsible for ensuring that the NASA Enterprise Architecture meets externally mandated requirements while satisfying internal customer needs in a cost effective manner. The CIO has primary responsibility, authority, and accountability, and is the approving official for the NASA Enterprise Architecture.

The NASA CIO will serve as the Program Manager for the Enterprise Architecture and will designate a manager for each of the projects within the program plan. The CIO has also designated a Chief Architect and has established a management structure to ensure an effective implementation, oversight and review.

5.1 Management

The following section describes the organizational structure, shown in Figure 4-1, including generic organizational roles and responsibilities. Specific roles, responsibilities, processes and procedures are defined in the CIO Management Plan.

Figure 5, NASA Integrated Information Infrastructure Program Funcitonal Organization



5.2 Responsibilities

The NASA Enterprise Architecture is subject to the controls outlined in "Managing Information Technology", NPG 2800.1. Roles and Responsibilities for Enterprise Architecture Management are:

5.2.1 CIO Board

The CIO Board, comprised of all the Enterprise and Center CIO's, will act as a forum for reviewing Enterprise Architecture issues. The Council will recommend actions to the NASA CIO as appropriate.

5.2.2 Customer Board

This board is made up of representatives from all major customer groups. The Board will ensure alignment of CIO priorities with programmatic and institutional needs.

5.2.3 NASA Enterprise Architecture Program Manager

The Program Manager has lead responsibility for program management. The Program Office has responsibility to implement the Enterprise Architecture Program according to this document, the approved Program Commitment Agreement, and the individually approved Project Plans. Specific responsibilities include:

- Setting objectives and requirements
- Setting scope, priorities, and controls module sequencing and timing
- Soliciting proposals for and approving subordinate projects
- Managing Program budget
- Allocating funding to projects
- Establishing framework for conducting program business within the Program Management Plan
- Managing Program Level risks
- Reporting (PMC, Process Owners, OMB, Congress, GAO, Office of the Inspector General (IG))
- Assessing Program performance
- Remaining accountable to customers for Program performance

5.2.4 Chief Architect

The NASA Office of the Chief Information Officer, Chief Technology Officer, has the roles and responsibilities of Chief Architect. The Chief Architect is responsible for planning, managing, and implementing changes to the NASA Enterprise Architecture. The Chief Architect is the interface between the Program Manager, the CIO Board and the Project Team. The Chief Architect will provide overall direction, control, and oversight of project implementation, including review of project performance, schedule, and cost status. The Chief Architect will have the authority to tactically manage the implementation of the Enterprise Architecture within the policies and guidelines established by the Office of the CIO.

5.3 Updating NASA's Enterprise Architecture - Basic Principles

One important part of the NASA Enterprise Architecture is the articulation of the Basic Guiding Principles that set direction for investment and Architectural decisions. NASA has settled upon the following Guiding Principles:

Alignment of IT with the Agency and Enterprise strategic plans. First and foremost in importance is that the IT Architecture provides positive support and enablement of the Agency and Enterprise Missions.

The General Purpose Architecture is intended to provide common support for common requirements when that can be done without compromising mission requirements. The Mission and Mission Support Architecture is intended to provide for the unique requirements that are not cost-effective, insufficiently broad in scope, or otherwise inappropriate to provide for through the General Purpose Architecture.

The Architecture must be economically and technically achievable. NASA has several missions which present Grand Challenges to the IT industry and academia. These challenges raise visionary perspectives of capabilities which are addressed through research and development programs within NASA or elsewhere. However, the operational IT Enterprise Architecture for day to day conduct of our business and mission functions must be constructed recognizing that constrained resources and prudent management call for utilization of technically proven and cost effective solutions.

Focus on areas or information needs with the highest payoff. Gap analyses and inventories of requirements will almost invariably result in long lists of needs or improvements that users or management recognize have value. NASA management of the Enterprise Architecture will consider those needs and requirements and prioritize and address them by conducting business case analyses of the areas that show the most promise to improve the net payoff and undertaking change initiatives appropriately.

Develop conceptual models to facilitate discussions. The NASA Enterprise Architecture, as does the Federal Enterprise Architecture, encompasses information and concepts ranging from the top level strategic vision to the detailed nuts and bolts implementation of specific hardware, software and systems. A key factor of the NASA implementation will be a strong reliance on modeling of the IT Infrastructure and Architecture, at multiple levels as appropriate, in order to support not only discussion and debate, but quantitative analysis. (This aspect of the Architecture is documented in Volume 4, The NASA Enterprise Architecture Program.)

Focus on the "Big Picture". At the Agency level, the NASA Enterprise Architecture will focus on the Enterprise level aspects of the "Big Picture". This will support top level investment and program level decision-making. However, the Enterprise Architecture Program also includes as a major component interfaces to Center and Mission level deployments as well as interfaces to lower level investments and deployments. This "Big Picture" view thus includes processes and deployment information critical to enabling integration and interoperability of function when that is cost effective.

Recognize information is a strategic resource that we need to manage. NASA is being proactive in corporately addressing sharing knowledge and information as a strategic asset. Building on previous studies and initiatives, NASA has identified and begun initiatives in Messaging and Collaboration and a Public Web Portal directed at improving the Agency's posture in this regard. The Enterprise Architecture will continue to provide focus on information management and sharing, whether it is internally directed, directed toward our business partners, or in pursuit of Service to the Citizen.

Include appropriate Performance Metrics. This will be accomplished as an integral part of the NASA Program/Project Management Process:

- Select metrics
- Collect data
- Assess progress

In all Architectural and investment decisions, NASA will always address the Key Questions to Consider:

What are the strategic objectives of the Agency?
What information is needed to support the Agency?
What applications are needed to provide information?
What technologies are needed to support the applications?

In summary, the Target Architecture should reflect NASA's view on the future uses and characteristics of information within the Agency and our requirement for focusing on opportunities to automate/simplify access to information. It must incorporate realistic technology forecasts, address the level of interoperability required between data sources and users of the data and identify the IT required to support the Agency's technical objectives. The target architecture must reflect reality, addressing budget issues and territorial concerns that will constrain the solutions.

5.4 Managing Information Technology Investments

The overall process for identifying and managing Information Technology investments is set out in the NASA Capital Planning and Investment Control (CPIC) process. The CPIC process helps NASA manage its investment portfolio and answer the questions whether the agency should be doing the work at all, whether someone else can do the work, and, if not, how best to undertake the work.

All IT investments are managed in accordance with NASA NPG 7120.5, NASA Program/Project Management Process. For Mission investments which constitute major IT investments, the investment and management process is conducted under the auspices of the responsible Enterprise, with the review and participation of the Chief Information Officer. For General Purpose infrastructure investments, the NASA Integrated Information Infrastructure Program Plan has been approved by the NASA Deputy Administrator and the agency's Program Management Council. This Program is managed in accordance with NASA's Program/Project Management Process (NPG 7120.5B), with the same formality and processes used for major mission programs. The Program Plan, dated August 4, 2003, sets out a strategy and management structure for the umbrella program and provides guidelines and a framework for development of detailed implementation plans.

Program Management is provided by a Program Manager reporting directly to the NASA CIO, supported by Program Executives for each of the service areas. Individual actions are managed by a lead under the auspices of the cognizant Service Area Program Executive and the NASA Integrated Information Infrastructure Program Manager. The role of each level of management for the Program is described below:

- The NASA Executive Council, chaired by the Administrator, and the NASA Institutional Council, chaired by the Deputy Associate Administrator for Institutions and Management, serves as steering committees for the Program, providing strategic guidance and oversight.
- The CIO Board reviews the Program structure and integration issues, providing recommended actions to the Program Manager.

- Customer Boards are created at the Program and service levels to ensure alignment of program, institutional and customer needs.
- The NASA CIO has overall responsibility and accountability and appoints the program manager and program executives.
- The Program Manager has management responsibility for ensuring that the Program meets customer requirements within schedule and cost targets, and complies with policies and strategic guidance.
- Program Executives manage assigned service areas and are responsible for the activities within that service area.

Individual actions are in various stages of the CPIC process – Planning, Development, Implementation, and Operations. Each Program Executive is responsible for preparing a business case for initiatives within their respective service area and initiating appropriate review processes.
In particular, as the result of previous analysis, initiatives in IT Security and in the Messaging and Collaboration component and Public Web component are in process.

6 Structure of the NASA Enterprise Architecture

The NASA Enterprise Architecture is structured into three major portfolio components:

Office Automation, IT Infrastructure, and Telecommunications IT (OAIT)

This category includes Office Automation investments that provide general purpose computing (e.g. email, desktops, help desk services) for both civil servants and contractor personnel, regardless of the program or project supported or fund source. Nine portfolios (Voice, WAN, LAN, Video, Desktop Hardware/Software, Data Centers, Application Services, Messaging and Collaboration, and Public Web) have been defined across three major service areas (Communications, Computing, and Electronic Work Environment.)

Multi-Program/Project

Multi-Program/Project IT is defined as IT infrastructure, products, and services that are not part of OAIT but do meet IT requirements that are not unique to a single program/project. These investments typically benefit multiple missions, programs or projects and "end of life" for a single project would not eliminate the need for the investment. Three major service areas and nine portfolios have also been defined for this category. The service area names are identical to those in the OAIT category, as are the portfolio names with one exception: Compute Engine Hardware/Software replaces the Desktop Hardware/Software portfolio. This is in recognition that in this investment category, computing platforms may range from science and engineering workstations to supercomputers.

Program Unique

Program Unique IT is defined as infrastructure, products and services that are either physically embedded in a flight or test article, or exist solely to meet the requirements of a single specific program or project. These investments would typically not be needed after "end of life" of the unique program or project that generated the requirements for the investment. It is possible that equipment purchased as part of these investments could be reused. It is expected that this would be reported as part of a new investment. The portfolio structure for this category is based on the NASA theme(s) and program(s) of which these investments are a part.

7 Office Automation, IT Infrastructure, and Telecommunications Portfolios

The NASA Enterprise Architecture is structured provide the framework for managing NASA IT infrastructure assets and services from an Agency perspective. The NASA Integrated Information Infrastructure Program is structured to align with the Agency's, Enterprise Architecture. The Enterprise Architecture integrates functions historically managed either as a separate Agency programs (e.g., Outsourcing Desktop Initiative for NASA (ODIN), NASA ADP Consolidation Center (NACC)) or managed primarily from a Center perspective (e.g., Local Area Networks, security). The NASA

Enterprise Architecture framework incorporates at its foundation a strong crosscutting security component.

The Enterprise Architecture provides an Agency perspective and management model for the investments captured in the Office Automation, IT Infrastructure, and Telecommunications portion of Exhibit 53 as submitted to Office of Management and Budget (OMB). The components that make up the investments defined in this part of Exhibit 53 are as follows:

- Communications Services
  - Wide Area Network
  - Local Area Network
  - Voice
  - Video
- Computing Services
  - Desktop Hardware and Software
  - Application Services
  - Data Centers
- Electronic Work Environment
  - Messaging and Collaboration
  - World Wide Web

7.1 Communications Services

The Communications Services component of the Program includes the agency's voice, data, and video network infrastructure, exclusive of any infrastructure elements that are unique to mission operations.

7.1.1 Wide Area Network

This project consists of a set of wide area networks that support production services, as well as services provided by several Internet Service Providers (ISPs). Today, ISP services have been procured by several Centers as an alternative for direct access to the Internet.
An independent economic analysis by Tecolote Research, Inc., examined four cases for providing Wide Area Network capabilities to NASA, including maintaining the "as is" approach. The most economical case is to replace/upgrade the existing network. This effort is one of the near term projects planned within this program. Assuming a transition period beginning in May 2003, the breakeven point is achieved in FY08.

7.1.2 Local Area Network

The LAN component incorporates all IT investments required to provide networking services within a building, campus, data center or Center, including hardware, software, and services (including wireless LANs, remote access, Domain naming services, network management, X500/directory services)

The operational state of Local Area Network services varies greatly from Center-to-Center. Since this capability evolved over time, there are a diverse set of LAN architectures across the Agency. In addition, service to the desktop varies from shared 10 megabit connections to dedicated gigabit connections. While there are no specific agency-wide projects identified in this area at this time, the development of a standard LAN architecture has begun and most Centers have LAN upgrade projects progressing as funding permits to provide 100 megabits to the desktop.

7.1.3 Voice

The Voice component includes all elements that provide voice services to users including hardware, software, services and communications that are not provided by NASA WANs
The voice element includes local and long distance telephone services, cell phone service, satellite phone service, teleconferencing, voice mail, fax, and ancillary services such as two way radios, emergency warning systems, and public address systems. Long Distance Service (LDS), 800 numbers, and calling cards are obtained from the GSA FTS2001 contract. Several Centers have upgraded their voice network infrastructure in recent years. There are no specific agency-wide projects identified in this area at this time; however, as the technology matures, the use of Voice over Internet Protocol (VoIP) will potentially enable the convergence of the voice and data infrastructures.

7.1.4 Video

This category includes investments required to support video and video distribution and video conferencing services used by Agency or Bureau to include hardware, software and support services - not including LAN or WAN.

Video services include Video Teleconferencing Systems (ViTS), digital video production equipment and facilities, video distribution systems and video repositories. While there are no specific agency-wide projects identified in this area at this time, it is expected that as networks are upgraded and desktop videoconferencing becomes more widely available, that there will be an opportunity for convergence with the voice and data infrastructure.

7.2 Computing Services

Included in this service area are desktop hardware and software service, application services, and those services provided by agency or Center multi-purpose data centers. Although there are a number of ongoing operational activities within this service area, there are no new agency-wide projects proposed at this time. This service area incorporates ODIN and NACC, activities independently managed in the past.

7.2.1 Desktop Hardware and Software

Desktop computing services to users include all general purpose, desktop computing hardware and software (OS, applications and utilities) components and services (including design, build, operations,

support and maintenance services) Includes peripherals/printers. Not included is email and calendaring client & servers or desktops whose primary uses are mission specific. Includes multipurpose help desks.

7.2.2 Application Services

Application services provide an end service to end-users. Applications services include the development, operations and maintenance of applications that are not desktop services. Included are IT investments in hardware (not a part of a data center), software and services required to provide application services remote from a desktop and not provided by a data center. This includes design, development, help and other support, operations and maintenance.

7.2.3 Data Center

A data center is a collection of IT hardware and software used for multiple purposes. These resources are usually funded and operated as a shared resource with management dedicated to operating the center. Mass storage systems are normally included as a data center unless the mass storage is integrated into some other IT facility. Included is data storage (digital data storage services, including hardware, software and services). Public Web hosting services are not included.

7.3 Electronic Work Environment

The Electronic Work Environment is a set of inter-related efforts that provide the NASA workforce with tools that improve the ability to work together and coordinate with NASA partners across all disciplines. This service area includes messaging systems that provide email and/or calendaring, collaboration tools that support virtual teaming, document and records management, and tools like XML that support and promote data interoperability across NASA, other agencies, and NASA partners.

7.3.1 Messaging and Collaboration

This component includes IT investments to provide Email, instant messaging, and collaborative tools. Two key near term elements are e-Presence and eXtensible Markup Language (XML).

7.3.1.1 E-Presence

Historically, NASA Headquarters, the Centers, and their satellite facilities have taken a “site specific” approach to the provision of electronic messaging services. As a result, the NASA electronic messaging environment today is a collection of diverse products and system implementations, with capabilities that vary from site to site. The objective of the ePresence initiative is to increase collaboration across the agency by providing a common electronic messaging system and a set of common collaborative tools to

support virtual teams. The messaging component of this initiative will complete a pilot activity in the first quarter of FY04 involving two solutions chosen for the pilot through a competitive process. If the pilot is successful, a project plan will be developed for agency-wide implementation.

The virtual teaming element is nearing completion of the first year of a pilot activity involving the two general categories of tools that support virtual team collaboration – those that enable virtual team meetings and those that provide a virtual team workspace. The WebEx tool for virtual team meetings has proven very successful and its use in a pilot mode will be continued through July 2004, at which time it will be transitioned to an operational environment on a fee for service basis. The tool piloted for virtual team workspace support has been more difficult to integrate into the normal team work processes, and investigation of the tools providing this capability will continue.

7.3.1.2 XML

As one of the Program's near term initiatives, the XML initiative supports data interoperability across NASA, other agencies, and NASA partners. XML is a family of standards and technologies that addresses the issue of achieving data integration. In the past, the solution was largely to develop central databases formed out of back-end legacy systems. Because of the complexity of such systems, little was gained from that approach. More recently, distributed databases and various middleware packages addressed distributed heterogeneous data. However, the time to develop the solution often seemed endless and the cost quite high.

XML offers a better, lower-cost alternative. XML has become a universal, vocabulary-based standard that uses a set of rules, guidelines and conventions for designing text formats in a way that produces Web-enabled files that are easy to produce and read. Systems based on current XML formats are able to deliver data in a manner all platforms can readily interpret, transfer, and store. Because of its universality, OMB has dictated that all e-Gov Initiatives should define and implement an approach for using XML. Where new developments or re-developments are pursued, XML must be considered as the default format for highly structured data as well as relatively less highly structured information, particularly at the User Interface layer but also at the Enterprise Repositories level as well. For legacy repositories that do not directly support XML, legacy to XML mapping and data transformation is to be explored for supporting interoperability across the data architecture. Use of voice XML (VXML) will be considered at the user interface level, especially for Government to Citizen (G2C) initiatives.

NASA has entered into an agreement with DOD/DISA to use their XML Registry to store NASA XML information. This project will advance the implementation of XML standards across NASA. The goals of the project are to:

- "Future proof" information against periodic technology change, facilitate integration and promote collaboration.
- Reduce the cost of integrating data, replication of data and warehousing (where these are clearly needed).
- Allow communication between applications running on different Web servers

7.3.2 Public Web

This component includes Center and agency-wide web development and hosting services focused on providing web access to information. The immediate focus has been on information provided to the citizen, with the most significant activity being the deployment of the OneNASA portal. The OneNASA Portal is intended to provide the public with a single point of entry to NASA's web environment, providing the audience with an easy way to navigate through NASA's public web content without knowledge of NASA organizational structure. The portal and its associated content management tools will enable the presentation of information in a way that reflects a consistent look and feel and will help ensure consistency and quality of the information presented.

Several Centers have deployed Center portals that are geared more toward providing easy access to information and tools intended for the workforce specific to their Center. Deployment of an "InsideNASA" portal to provide a similar capability, but from an agency-wide workforce perspective, is currently under consideration.

7.4 Cross-Cutting Components

The NASA Enterprise Architecture includes several Cross-Cutting Services which address common requirements associated with all of the other architectural components. These cross-cutting services include IT Security services, Software Engineering services and IT Asset Management.

7.4.1 IT Security Services

Security crosscuts all of IT and is an integral component of all the service areas and each of the components included within this program. NASA policy for ensuring that adequate security is provided for all agency information collected, processed, transmitted, stored or disseminated is set out in NASA Policy Directive 2810.1, "Security of Information Technology". Detailed procedures and guidance are contained in NASA Procedures and Guidelines 2810.1. These instructions provide direction for ensuring that safeguards for the protection of the integrity, availability, and confidentiality of IT resources (e.g., data, information, applications, and systems) are integrated into and support the missions of NASA.

In addition to agency and Center-wide ongoing security operations, this program includes three near term agency-wide security actions to correct known vulnerabilities, reduce barriers to cross-Center collaboration, and provide cost-effective IT security services in support of Integrated Financial Management Program and e-Gov initiatives. The current security initiatives are:

7.4.1.1 Account Management

Today, employees need multiple accounts to access the information required to perform their jobs, such as e-mail, remote access networks or applications. And, the number of applications being developed and maintained on various platforms by multiple business units within an organization continues to grow. Users typically have to sign-on to multiple systems, necessitating an equivalent number of sign-on dialogues, each of which may involve different usernames and authentication information. System administrators are faced with the challenge of managing the user accounts within each of the multiple systems in a coordinated manner in order to maintain the integrity of security policy enforcement.

This project provides a cost-effective approach for managing computer access privileges within and between Centers for agency-wide applications and services. The objective of the Account Management Project is to improve security and reduce the cost of managing accounts within networks, applications, and systems across NASA. A key element of this project is the automation of the account management process to enable:

- Management of large numbers of users with disparate requirements
- Support across multiple organizations, systems and applications
- Identification of unapproved accounts and those where authorization is no longer necessary
- Ability to immediately populate changes to user accounts throughout the system
- Automatic creation of user rights based on established NASA security policies and authentication by the sponsor
- Controlled delegation of account administration (new accounts, changes, etc.) to appropriate business units or groups
- Interface with external systems
- Finally, this project incorporates centralized audit trails that track access requests and support independent audits of security practices and procedures. These audit trails capture all aspects of the administration of access rights from initial requests for access to changes in account details.

7.4.1.2 Network Security Perimeter

This project provides a consistent and managed interface for applications and services and reduces deployment complexity and management risks. The objective is to improve agency-wide interoperability, efficiency of operations, reliability, and most of all – security. A consistent perimeter will also reduce the risk in deployment of agency-wide applications.

The differences in Network Security Perimeters (NSP) across the Agency are roadblocks for agency-wide programs and projects that need to share information, services, and resources across the Centers. In order to create an agency-wide service, customers may need to interface with up to eleven different security organizations, each of which has a different set of policies and NSP implementations. Furthermore, the demand from various programs for increased LAN and WAN bandwidth has stressed some of the agency's NSP implementations to the point where they are a source of network bottleneck and instability.
In an effort to support a secure "One NASA" approach to Information Technology, the agency needs to establish a common Network Security Perimeter for each field center. This standardization is required to ensure or improve interoperability, efficiency of operations, reliability, and importantly - security.

Additional benefits of standardization include cost savings from agency bulk purchases of equipment, and single development and testing effort (instead of every center developing and testing their own); better support of new/future requirements for applications and protocols (i.e. wide-area multicast, IP telephony, jumbo-frames, Quality of Service, etc.); and improved overall manageability on an agency level.

7.4.1.3 Cyber Identity Management

This project provides agency-wide authentication services and integration of the Uniform Universal Person Identity credentials into existing operational applications and systems. A common approach to identity management will allow agency-wide access to consistent information about people, groups, roles, and resources. Conflicting and duplicative directory entries will be eliminated, significantly improving security.

As an organization increases it reliance on Internet-accessed business systems, applications, and transactions, Identity Management becomes the central pathway through which it must navigate to efficiently utilize those applications and transactions. By necessity, organizations are moving to the concept of federated identity that can scale across organizational and application boundaries. The concept of a federated or common identity extends account profile and access management to third parties who need to access resources, and similarly, enables one to project their identity to others across organization.

Within NASA, users include employees, contractors, universities, suppliers, partners, stakeholders and the public. NASA Centers have multiple user intranet accounts such as email, calendar, Web applications, plus legacy and core non-Web applications. The cost of administering duplicative directory content is very high and inaccurate and incomplete data takes a toll on user productivity.

The business repercussions of multiple user directories include the costs and opportunity costs of dedicated IT resources, and the increased likelihood of inaccuracy, redundancy, and inconsistency. Because users have account profiles in multiple locations, the chance that some changes will only be partially executed is very likely in that a change might occur in one data repository and not another. The organization also assumes liability for inappropriate, embarrassing and, in some cases, illegal access breaches because user information and access is inconsistent across data repositories. Mistakes in user information translate to a further dedication of resources in the form of reactive problem solving instead of proactively focusing on more strategic initiatives.

7.4.2 Software Engineering

This program incorporates software engineering activities in support of the service areas defined above and below, including requirements development and management, configuration management, system testing and performance monitoring tools. NASA has specific governing policies with respect to software engineering:

- NASA Policy Directive 2820.1, "NASA Software Policies"
- NASA Standard 2100-91, "NASA Software Documentation Standard"
- NASA Standard 2201-93, "Software Assurance Standard"
- NASA Standard 2202-93, "Software Formal Inspection Process Standard"
- NIST Standards

While historically NASA's software engineering activities have focused primarily on mission-specific systems, the agency is currently in the process of chartering a Software Steering Board to ensure an integrated NASA-wide approach to the areas of software engineering, software assurance, Independent Verification and Validations (IV&V) of software, software related research, and training in software disciplines.

7.4.3 IT Asset Management

In recognition of the critical role and high dollar value of capital assets, the NASA Strategic Plan contains a very specific goal of achieving excellence in the institutional management of capital assets, including implementation of best practices. The NASA Associate Deputy Administrator for Institutions and Asset Management along with the Institutional Management Council provide direction and oversight for capital asset management. The NASA Program Management Council also provides asset management oversight for specific programs. Additional requirements are found in the following instructions:

- NASA Policy Directive NPD 4200.1A, "Equipment Management"
- NASA Procedures and Guidelines 4200.1E, "NASA Equipment Management Manual"
- NASA Procedures and Guidelines 4200.2B, "Equipment Management Manual for Property Custodians"
- NASA Policy Directive 8831.1D, "Maintenance of Institutional and Program Facilities and Related Equipment"
- NASA Procedures and Guidelines 8831.2D, "Facilities Maintenance Management"

NASA is in the process of defining requirements for an Integrated Asset Management (IAM) system planned for deployment as a component of the Integrated Financial Management (IFM) Program. The Integrated Information Infrastructure Program incorporates the legacy IT asset management systems and services. When the IAM system becomes operational, it will be incorporated into the Integrated Information Infrastructure Program as the legacy systems are phased out.

8 Program Unique and Multi-Program Project Portfolios

Many of NASA's Mission Operations require IT services that are unique to the mission requirement and not suitable for provisioning through a General Purpose Infrastructure. In general, the service requirements include such factors as very high reliability, very high performance or unique functionality or the missions involve human life or very large operational investments requiring dedicated processing capabilities. These unique requirements notwithstanding, all such systems are included explicitly in the NASA Architecture. It must also be noted that in a number of such Mission areas, NASA is a major participant in Inter-Agency and industry working groups or task forces supporting efforts to develop standards and solutions that can be leveraged across many applications and agencies. In addition, efforts are made to architect Mission Systems so as to utilize common components of the General Purpose infrastructure where the requirements allow.

Program Unique and Multi-Program/Project portfolio areas are managed within the Mission Directorates responsible for the Missions. The major Mission systems considered in the Enterprise Architecture are the same systems identified to the Office of Management and Budget in the NASA budget process. The programs and tasks that implement the objectives are funded through eighteen themes, which represent the Agency structure for budget planning, management, and performance reporting. The relationship between each theme and Enterprise is shown in the following table.

Table 1

Theme	Enterprise
Solar System Exploration (SSE)	Space Science
Mars Exploration (MEP)	Space Science
Astronomical Search for Origins (ASO)	Space Science
Structural and Evolution of the Universe (SEU)	Space Science
Sun-Earth Connection (SEC)	Space Science
Earth System Science (ESS)	Earth Science
Earth Science Applications (ESA)	Earth Science
Biological Sciences Research (BSR)	Biological and Physical Research
Physical Sciences Research (PSR)	Biological and Physical Research
Research Partnerships and Flight Support (RPFS)	Biological and Physical Research
Aeronautics Technology (AT)	Aerospace Technology
Education Programs (EP)	Education
International Space Station (ISS)	Space Flight
Space Shuttle Program (SSP)	Space Flight
Space and Flight Support (SFS)	Space Flight
Space Launch Initiative (SLI)	Aerospace Technology
Mission and Science Measurement Technology (MSM)	Aerospace Technology

Innovative Technology Transfer Partnerships (ITTP)	Aerospace Technology

Furthermore, each program's corresponding theme and Enterprise is shown in the next table. Also, their roles as Program Unique IT or Multi-Program / Project IT are listed.

Table 2

Mission/Program	Enterprise	Theme	Program Unique IT or Multi-Program / Project IT
ARC: Aerospace Technology Support System	Aerospace Technology	Aerospace Technology(AT), Space Launch Initiative(SLI), Mission and Science Measurement Technology (MSM), Innovative Technology Transfer Partnerships(ITTP)	Multi-Program / Project IT
ARC: NASA High End Computing Columbia	Aerospace Technology	Aerospace Technology(AT), Space Launch Initiative(SLI), Mission and Science Measurement Technology (MSM), Innovative Technology Transfer Partnerships(ITTP)	Multi-Program / Project IT
GSFC: Earth Observing Sys Data Info Sys	Earth Science	Earth System Science(ESS)	Multi-Program / Project IT
GSFC: NASA Center for Computational Services	Earth Science	Earth System Science(ESS)	Multi-Program / Project IT
GSFC: Hubble Space Telescope Mission Ops IT	Space Sciences	Astronomical Search for Origins(ASO)	Program Unique IT
GSFC: Space and Ground Network IT Support	Earth Sciences	Earth System Science(ESS)	Multi-Program / Project IT
JSC: Flight Operations	Space Flight	Space & Flight Support(SFS)	Multi-Program / Project IT

JSC: Mission Control Center	Space Flight	Space & Flight Support(SFS)	Multi-Program / Project IT
JSC: Space Station Production Facility	Space Flight	International Space Station(ISS)	Program Unique IT
JSC: Space Shuttle Program Flight Software	Space Flight	Space Shuttle Program(SSP)	Program Unique IT
JSC: Software Development/Integration Laboratory	Space Flight	International Space Station(ISS)	Program Unique IT
JSC: Space Shuttle Program Cockpit Avionics Upgrade	Space Flight	Space & Flight Support(SFS)	Program Unique IT
JSC: Space Station Training Facility	Space Flight	Space & Flight Support(SFS)	Program Unique IT
JSC: Integrated Planning System	Space Flight	Space & Flight Support(SFS)	Multi-Program / Project IT
JSC: Space Shuttle Program Program Integration	Space Flight	Space & Flight Support(SFS)	Program Unique IT
KSC: Operational Television System Modernization	Space Flight	Space Shuttle Program (SSP)	Program Unique IT
KSC: Launch Control System	Space Flight	Space & Flight Support(SFS)	Program Unique IT
KSC: Shuttle Processing Support	Space Flight	Space Shuttle Program (SSP)	Program Unique IT
KSC: Ground Operations	Space Flight	Space Shuttle Program (SSP)	Program Unique IT
KSC: Integrated Logistics	Space Flight	Space Shuttle Program (SSP)	Program Unique IT
MSFC: Payload Operations and Integration	Biological and Physical Research	Research Partnerships & Flight Support (RFPS)	Program Unique IT

The above relationships provide a direct link between NASA's Vision and Mission to specific programs and missions.

These investment area systems are briefly described in the section" and in more depth in Volume 3.

9 Office Automation, IT Infrastructure, and Telecommunications Portfolio - Technical Summary Description

9.1 Introduction

Throughout the following sections, the elements of NASA's general purpose IT infrastructure are described in the context of "as is" and "to be" conditions. The "as is" architecture is the current baseline of operational systems. Many "as is" legacy systems are identified and briefly discussed within this architecture document; however, the complete inventory of legacy systems is not included.

9.1.1 Technology Flashpoints

Technology Flashpoints are any real or perceived issues, gaps, or deficiencies identified in the Architecture with respect to the current "as-is" deployment of the component, especially with respect to changes anticipated to be occurring in the marketplace in the future. Flashpoints are used, in part, as a guide in determining areas where Architecture and/or Standards may need attention or as a guide in helping determine Business Case analyses or IT initiatives.
Detaildd technology flashpoints are included in *NASA Enterprise Architecture: Volume 2, General Purpose Architecture*. A Gap and Flashpoint Analysis is included in Section 12 of this document.

9.1.2 The "To-Be" State

The "to be" state is the long-term vision to be achieved by the agency over the next 3 to 5 years. The detailed discussion of the "To be" architecture is discussed in Volume 5.

9.2 Desktop Hardware and Software Component

9.2.1 Introduction

The NASA Desktop Component consists of the desktop elements of the overall Computing Services Segment. This includes Wintel, Mac and Unix desktops as well as laptops and locally attached printers, all of which are provided with a wide variety of services.

The Desktop Component provides two major functions: (1) hardware and software sufficient to conduct client-side Office Automation, Personal Productivity, and general analytical functions (including science or engineering analyses that do not present special requirements) and (2) connectivity to the networks and host based services for corporate functions.

This component interfaces to the Application Services component for access to a wide variety of both centralized and distributed applications requirements for users. It interfaces to the Data Center component where centralized support functions can be leveraged for economies of scale and increased reliability both within the specific Center and across the Agency. It interfaces to all components of the Communications Services segment and of the Electronic Work Environment segment.

9.2.2 As is Condition

Desktop service provisioning is accomplished either via the NASA-wide ODIN contract or through Center-specific Support contracts. Most of the General Purpose desktops are serviced by the local ODIN service provider. In addition, at some Centers where mission requirements permit, a portion of Mission Support and Mission function desktops are also provisioned by ODIN.

Desktops may be PC (Wintel), Apple Macintosh, or one of various UNIX/Linux Operating System/Hardware platforms. ODIN seats are classified as General Purpose 1 (GP1), General Purpose 2(GP2), General Purpose 3 (GP3), Scientific and Engineering 1 (SE1), and Scientific and Engineering 2 (SE2). Non-ODIN seats are not classified. NASA Standard 2804, Minimum Interoperability Software Suite, defines a complete suite of required Office products, electronic mail client, web browser, PDF viewer, calendar, access capability to centrally served Windows applications, electronic forms, and other recommended software for meeting required functionalities. The standard includes specific Operating System releases for PC, Mac and UNIX systems. Other functionalities include required ftp clients, news readers, viewers, anti-virus, audio/video players, PKI client software and recommended secure shell, 3270 client emulators, X-windows, PostScript previewers, and data conferencing clients.

The specific hardware implemented for each ODIN seat is determined by a benchmarking process conducted for NASA by Alterion, Inc. and must be compliant with NASA Standard 2805, Minimum Hardware Requirements for Interoperability. Hardware and software for non-ODIN (Mission Support or Mission) seats is determined by the user. However, if the seat is used to interoperate with the rest of the NASA Infrastructure, it is required to comply with NASA Standards 2804 and 2805 and with Security requirements of NPG 2810.1.

9.2.3 Systems Description and Operational Concept

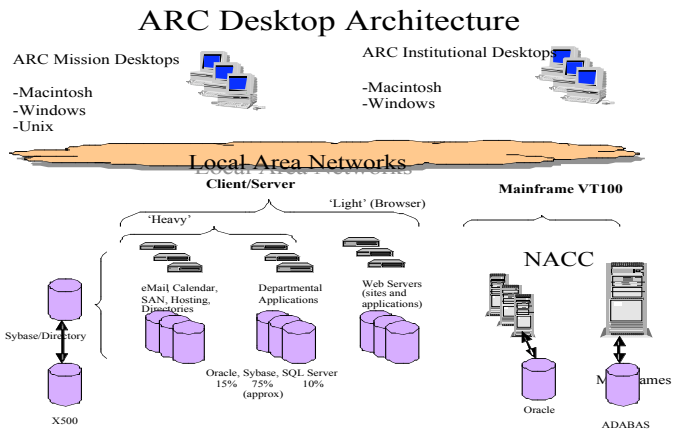
At each Center, the Desktop is the primary window of the user to both personal Office or Productivity functions as well as access to served services across the Local Area and/or Wide Area Networks. Security is provided at most Centers by logon/password at the client level and/or with logon/password to the Local Area Network. Software configuration management is carried out at most Centers using one or more software push and/or pull mechanisms such as Microsoft Systems Management Services, netOctopus, Marimba, or similar product. The specific implementation is generally that selected as most cost-effective by the local ODIN outsource service provider, and there is no requirement for standardization at this time. Additionally, most Centers employ an automated hardware and software inventory tool at least for their ODIN supplied desktops using tools such as Asset Insight. Help desk

services are provided at almost all Centers through a series of first level, second level, and dedicated systems support desks as the customer requirements warrant. Essentially all General Purpose client desktops at all Centers are deployed within at least one Center-level firewall with only client-initiated access to the Internet allowed. Some Centers have a double firewall structure. See the descriptions for the Local Area Network component for more specifics related to network security implementations. At most Centers the ODIN and General Purpose desktop support is focused on the PC and Mac platforms. However, at some other Centers, administrative support for UNIX systems is included.

9.2.4 Production Network Diagram

Although there are minor variations, the Ames Research Center deployment is typical of all Centers.

Figure 6, ARC Desktop Architecture Production Network Diagram



9.2.5 Systems and Support

NASA policy is that every employee shall have access to an interoperable desktop compliant with NASA standards 2804 and 2805 to provide minimum interoperability capabilities. In practice, this generally implies one desktop per employee equivalent to at least the ODIN GP1 category capability.

The primary support is provided at all Centers by the local ODIN service provider through their Help Desk and various second level support structures.

Support provided includes:

- Standard system, security, and log monitoring
- Troubleshooting user application and system anomalies
- System backups and restores
- Actively investigate software and firmware upgrades
- Maintain emergency shutdown/startup procedures
- Maintain participation in production configuration control meetings.
- Maintain a catalog of installed-software
- Secure administration user-ids and passwords
- Maintain web content such as frequently-asked questions, problem matrix, UNIX and RAS documents.
- Respond to feedback submissions from the Help Desk, support mailing list, and User Feedback web pages.
- Actively check software and hardware vendors web pages for service packs, hotfixes, and software and firmware upgrades. Then determine which ones should be installed and when.
- Maintain an electronic log of hardware and software maintenance activities performed.
- Monitor disk space on all servers.
- User-id administration

These distributed seats require services from the other components in order to fully function.

9.2.6 Compliance

All Centers require all ODIN desktops and all interoperable desktops to be compliant to:

NASA Standard 2804G, Minimum Interoperability Software Suite
NASA Standard 2805G, Minimum Hardware Configurations
NASA Standard 2814A, Technical Architecture – Volume 1, June 27, 2000
NASA Standard 2814A, Considerations for Agency-Wide and Inter-Center Deployment of IT Services and Applications – Volume 2, June 27, 2000

9.2.7 Capabilities

The Desktop component provides the capability for NASA Users to conduct their normal office functions and connect to corporate applications in an effective and efficient manner.

9.3 Application Services Component

9.3.1 Introduction

Application Services is a component that provides an end service to end users, including design, development, help and other support that are not provided by the Desktop component. Included are IT investments in hardware (not a part of a Data Center), software and services required to provide application services remote from a desktop and not provided by a Data Center.

The goal of this Service Area is to (1) provide an underlying capability for subsets of the customer community to meet their unique needs when requirements dictate and to (2) provide the opportunity for those customer subsets to leverage economies of scale as relative costs and service requirements permit. It is assumed that centralization of service or function can potentially offer savings in terms of economies of scale. It is also assumed that centralization can have potential integration costs in terms of a broader scope of configuration and management process, potentially requiring extra capabilities only a small portion of users will utilize, and potentially decreased responsiveness to user requirements. Management of this component will try to balance these factors by conducting business case analyses for classes of applications as it becomes evident that specific applications establish a sufficiently broad customer base.

9.3.2 As is Condition

There are hundreds of applications services in place within the Agency. Lists of applications, by Center, are included in Volume 2. Some application services provide services to the entire Agency, other

applications services provide services to specific centers, while yet others provide services to small subsets of users with special requirements.

The scope of development support ranges from general-purpose web applications that provide access to user managed content, to full-featured transaction processing and workflow management systems. In addition, individual organizations develop and maintain organizational web systems and applications.

There are three ways in which this component reduces costs or improves efficiencies.

> First, the applications rely on a common component infrastructure. The organization and management of the full spectrum of application services is built upon the common component infrastructure. Applications are acquired or built consistent with the common Desktop environment standards whenever possible. Client-server or multi-tier applications are encouraged to utilize servers in Data Center whenever possible. Compliance with Communications standards and Collaboration and Messaging standards are also reviewed so as to insure interoperability and cost-effectiveness.
>
> Second, the applications utilize economies of scale. The common component architecture fosters specific applications implementers to choose to use hardware in the Data Centers and/or the outsourced desktop support structure as much as possible.
>
> Third, NASA fosters a broad utilization of IT to meet specialized requirements. Although NASA has many functions in common across the Agency, there are also widely varying requirements for which decentralized services are optimal. In fact, the ODIN Desktop Outsourcing contract offers a catalog of optional special-use hardware and software items numbering in the thousands.

The three-pronged nature of this approach offers the savings of centralization when they exist while providing an environment for end-users to meet their unique needs when a centralized solution is not most effective.

9.3.3 Systems Description and Operational Concept

The purpose of the NASA Applications Services is to increase productivity by automating otherwise manual functions. In recent years, applications have become much larger and centralized thus lending themselves to increased reuse across the Agency. As this trend continues more and more functions might be consolidated and systems more integrated. Although custom applications utilized at NASA covers a broad range of capabilities, functions supported include:

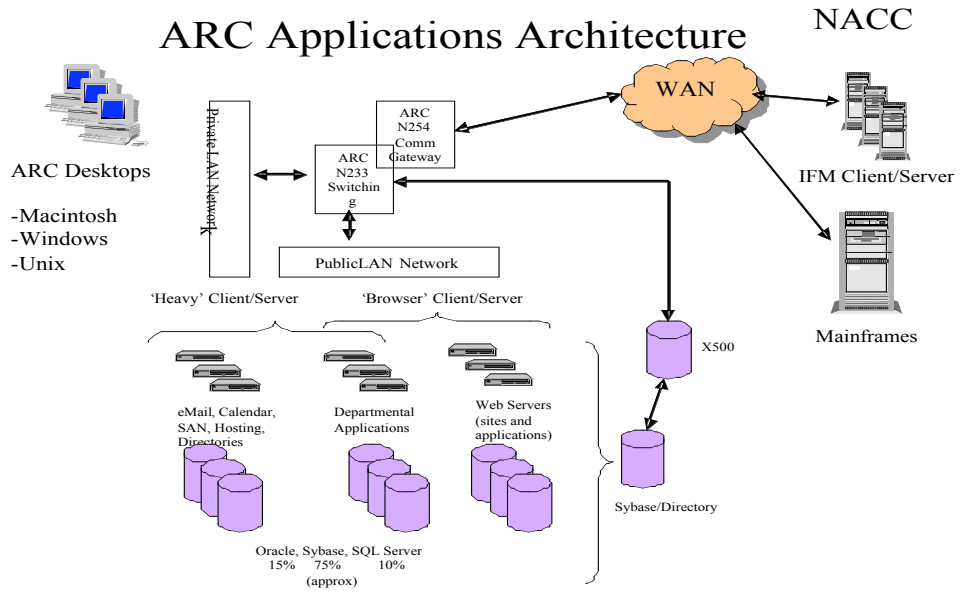
- Finance/Accounting/Budget
- Payroll and Personnel
- Property and Procurement
- Center Facility and Logistics Management
- General science and engineering analyses

- Engineering Design Data Management
- Electronic Document Management
- Digital Imagery Management
- ISO Corrective Action Process
- General and Administrative covering:
  - Incident Reporting
  - Action Tracking
  - Document Management
  - Project Management/Financial Dashboard
  - Program Status
  - Resource Management
  - Awards
  - Information Disseminating applications
  - Security
  - Forms Dissemination
  - Knowledge Sharing
  - Law/Legal
  - Satisfaction Surveys/Conference Registration
  - Launch support

9.3.4 Production Network Diagram

Specific deployment configurations may vary from Center to Center. However, Figure 8 below depicting the Production Network that supports the Ames Research Center Applications Services Component is a satisfactory depiction of most Centers. Users access applications from their desktops, through the networks, running on distributed mainframes or servers in Data Centers or elsewhere.

Figure 7, ARC Applications Architecture Producton Network Diagram



9.3.5 Systems and Support

Applications span the Mainframe, Client/Server, and Web-based boundaries.

For the Mainframe architectural component, applications are written in standard COBOL and in ADABASE Natural. These applications reside on the Marshall LPAR partition and are accessed via NASA networks and workstations via emulation utilities.

Client/Server Custom Applications are written in a variety of languages including File Maker Pro, Visual Basic, MS Access, Visual Foxpro, C++, and Powerbuilder. These languages run on the client side and require a Windows 2000 and/or Mac Operating System to execute.

For the Web-based architectural component, applications are often written in the Cold Fusion developmental language and environment. This requires Cold Fusion and SUNONE Server software to execute. Crystal Enterprise is often used to facilitate the development of graphically rich reports. Several Centers are moving forward using XML/DSML Transport Layer requiring Oracle OC4J Java J2EE container with JDK and Cold Fusion MX.

Systems and support consists of the following elements:

- Systems hardware and software
- Development and engineering

- Configuration Management and Planning

Support for applications is provided by a combination of sources. Some of the more common applications are provided by the Center ODIN service provider. Most applications are Center-specific and developed and supported by on- or near-site support contractors. Many of the centralized applications are provided through the NASA ADP Consolidation Center at the Marshall Space Flight Center in Huntsville, Alabama, and support for those is provided by the PRiSMS contract.

9.3.6 Facilities

Facilities for application services are typically captured in the Data Center or a distributed location accessible from the network. Mainframe applications reside at Marshall Space Flight Center NASA ADP Consolidation Center located in Huntsville, Alabama.

9.3.7 Compliance

Applications are to be compliant with the following: NASA STD 2804, NASA STD 2805, NASA STD 2810, and Section 508 Accessibility requirements of the Americans with Disabilities Act.

9.3.8 Capabilities

Capabilities provided by the applications are categorized into the following major areas.

Finance/Accounting/Budget applications constitute the tools used by NASA to formulate and execute budgets and operating plans, and perform the total accounting for the Agency. This class of function is being encompassed within the Integrated Financial Management Program.

Payroll and Personnel applications provide the automated capability to manage NASA's human resources. A primary tool is the NASA Personnel/Payroll System (NPPS). There are a variety of other applications that support NASA wide human resources activities. Again, many of these functions are being incorporated in the Integrated Financial Management Program.

Property and the Procurement applications include a variety of important applications used to facilitate the NASA procurement and procurement analysis processes and to track NASA assets. A key procurement application is the NASA Procurement Management System (NPMS), which provides the automated repository of information on NASA contracts, contractors, subcontractors and geographic distribution of funds associated with these contracts and subcontracts. Another important automated procurement system is the University Management Information System (UMIS), which provides the capability of tracking and maintaining the status of grants and contracts, awarded to colleges and universities to perform research and development work for NASA. Some of these functions are being incorporated in the Integrated Financial Management Program.

Facility and Logistics Management applications provide information and tracking on Center facilities operations, maintenance, repairs, and logistics functions such as supply management, printing and photography, and shipping/receiving.

General Science and Engineering Design Data Management applications provide analytical tools and computational resources that are modest in nature (i.e., do not require supercomputers, parallel processors, or advanced graphics capabilities). The applications may be server based or may be keyserved applications. Examples include Computer Aided Design and Engineering tools to archive and manage engineering drawing files.

Electronic Document Management applications provide for document management, document review and approval processes, and long and short term documentation storage and retrieval.

Digital Imagery Management applications provide automated support for capturing, storing processing, and retrieving digital images such as photos of visitors for badge control through photos of excess or pool equipment in storage and available for use.

ISO Corrective Action Process applications allow for tracking ISO corrective actions in order to maintain certification.
The General and Administrative applications constitute a broad category of automated systems, which provide support for a number of business activities and general office administration. An example is the Headquarters Action Tracking System (HATS), a software application used across Headquarters to track and archive action items and correspondence. Document Management Systems is another example of a commonly used application with minor variations to meet the documentation organization, processing, storage, and retrieval needs of different offices. The Legislative Affairs Database (LADS) application at Headquarters tracks Congressional visits and provides reports on these visits. Web based surveys are used at most Centers to collect information from employees.

9.4 Data Center

9.4.1 Introduction

The Data Center component is defined to be IT hardware and software that is used for multiple purposes. This component only includes those shared resources that provide General Purpose functions. Those facilities that support specific mission requirements are captured under the specific missions.

NASA Data Centers provide users and project or departmental applications the following in NASA's distributed networked environment:

- Convenient and secure access to structured and unstructured data repositories
- Database hosting configuration, and administration
- Application hosting configuration, integration, and administration
- Network attached storage and near-line storage.

- Experienced administration staff
- Leveraged economies of scale
- Site- or bulk-license purchase

9.4.2 As is Condition

Although GSFC and JSC report no General Purpose capabilities within this definition, all other Centers have one or more General Purpose Data Centers. The Data Centers provide server farms to host various applications as well as mass storage and/or backup recovery systems. Specific configurations are described in Center documents.

9.4.3 Systems Description and Operational Concept

A NASA Data Center provides fully supported, reliable, and economical database services and products, including commercial database management systems and servers, database storage, and middleware products for database access. The database hosting service is generally available laboratory wide and significantly reduces the costs, resources, and commitment a project needs for a data management solution.

A NASA Data Center also hosts enterprise applications that require integration and support with institutional services and applications that are data-intensive, requiring relational or object database and/or access and management of large scales of data. The Application Hosting Service provides hosting, support and maintenance for applications via hardware, software, mass storage and operational support.

The hosting is generally provided on farms of servers (PC, Mac and UNIX) whose numbers and configurations vary. Details are provided in Center specific documentation.

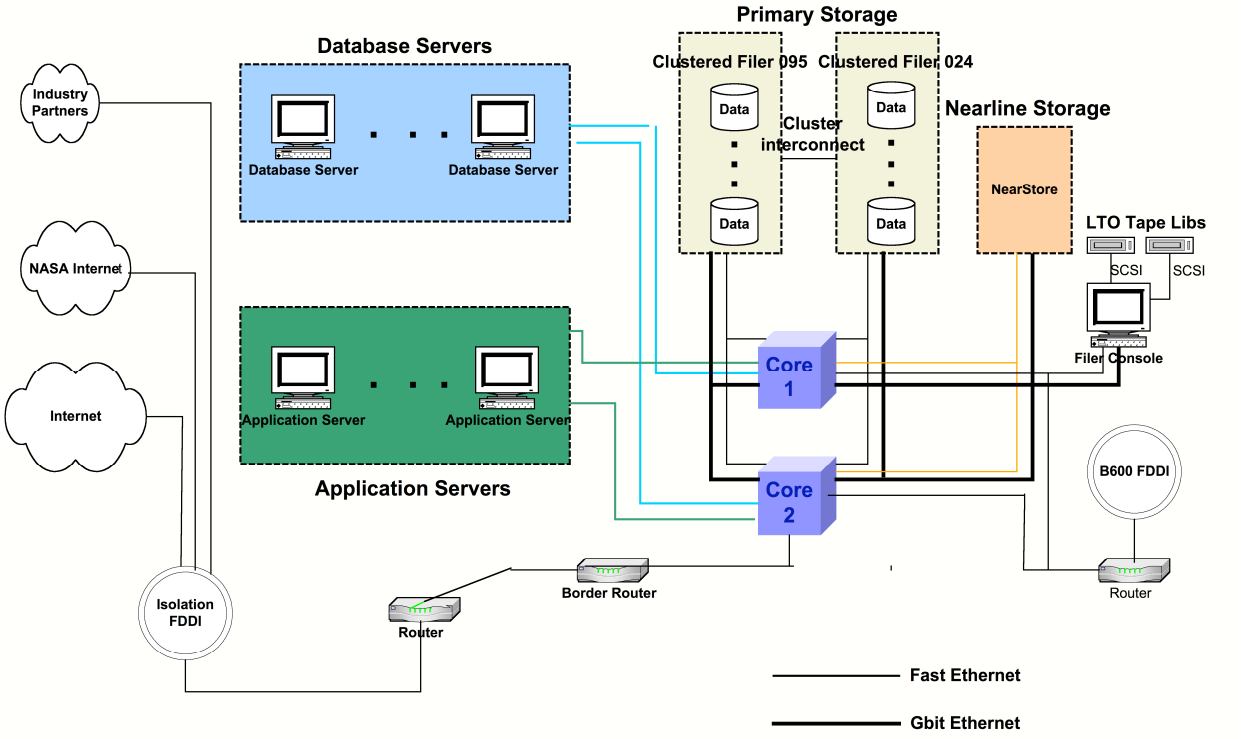
Operational Concept

Users or Application Service providers typically contract with the Data center to provision the hardware, facility and support. The User or Application Service provider may have controlled remote administrative access to portions of the installed software or servers. All Centers with a Data Center have the resources in controlled access facilities.

9.4.4 Production Network Diagram

Although specific implementations vary some, the Network Diagram for the Jet Propulsion Laboratory provides a typical composite view of the service.

Figure 8, JPL Data Center Producton Network Diagram



9.4.5 Systems and Support

The systems are generally server farms with tens of servers, some print management and distribution capability, and one or more mass storage servers and storage silos. In most cases the Local Area Network and Wide Area Network hardware is resident in the same facility as the Data Center.

Systems which hold user-critical data are administered and monitored 24 hours a day, seven days a week, with point-in-time recovery. For non-critical data, support is available during normal office hours.

9.4.6 Facilities

At most Centers the Data Center is in a dedicated facility. These facilities include raised floor space, power redundancy and distribution, temperature control, smoke detection and fire suppression systems, and physical security measures and surveillance. In most instances, these facilities are physically located where the Center mid-range processors, mainframes, and supercomputers resided before those functions were consolidated.

9.4.7 Compliance

All Centers report compliance with NPG 2810.1, Security of Information Technology.

9.4.8 Capabilities

Data Centers generally provide a capability for users, groups of users and departments or projects to utilize shared computational resources at lower cost, with higher security, and with more reliability and responsiveness than they are likely to achieve on their own. In some instances the requirements exceed those which are cost effective for a Data Center to provide to all customers, in which case the customers may provision their own services.

9.5 Wide Area Network Component

9.5.1 Introduction

This component consists of a set of Wide Area Networks (WANs) that provide production services as well as services provided by several commercial Internet Service Providers. The bulk of the services are provided through the NASA Integrated Services Network (NISN) managed at the Marshall Space Flight Center. Many Centers also have other WAN gateway connections for either mission specific functions or for services not available through NISN.\

9.5.2 As is Condition

The NISN WAN provides for the transport and delivery of NASA WAN communications services both domestically and internationally. The NISN provides both digital and analog services, dedicated and switched circuits, packet data transport, multi-protocol Wide Area access, domain name services, and various data networks.

At each Center it is typical that the WAN connects to the local area network (LAN) via a security perimeter network referred to as the "Isolation Network". This isolation network provides firewalls and routing to separate external networks, public networks, and internal networks.

9.5.3 Systems Description and Operational Concept

NISN provides two types of services, Standard IP (SIP) and Premium IP (PIP). NISN's SIP service provides routes to a limited number of Internet and Internet 2 sites. NISN's PIP service provides routes to other NASA Centers and has the capability to route to the Internet. PIP services are differentiated

from SIP services in that PIP provides a higher performance level, higher priority for problem handling, and is not directly connected to the general Internet.

The Center level Office of the Chief Information Officer, is typically the sole managing agent for the production networks. This includes the accountability for cabling, electronics, and security of WAN devices managed at the center.

All Centers utilize NISN but may also utilize commercial or other WAN services in addition to NISN for special purposes:

GRC: The other GRC ISP is a DS-3 through the Ohio Academic and Research Net (OARNET). The OARNet circuit and the NISN PIP service are peered via BGP with a redundant web cache.

GSFC: The GSFC wide area architecture consists of circuit based communications with component Center at Wallops Flight Facility, Goddard Institute for Space Science and the NASA Independent Validation &Verification facility. All other wide area access is obtained through NISN.

LaRC: Also utilizes a connection to Cox Communications for redundancy and improved service.

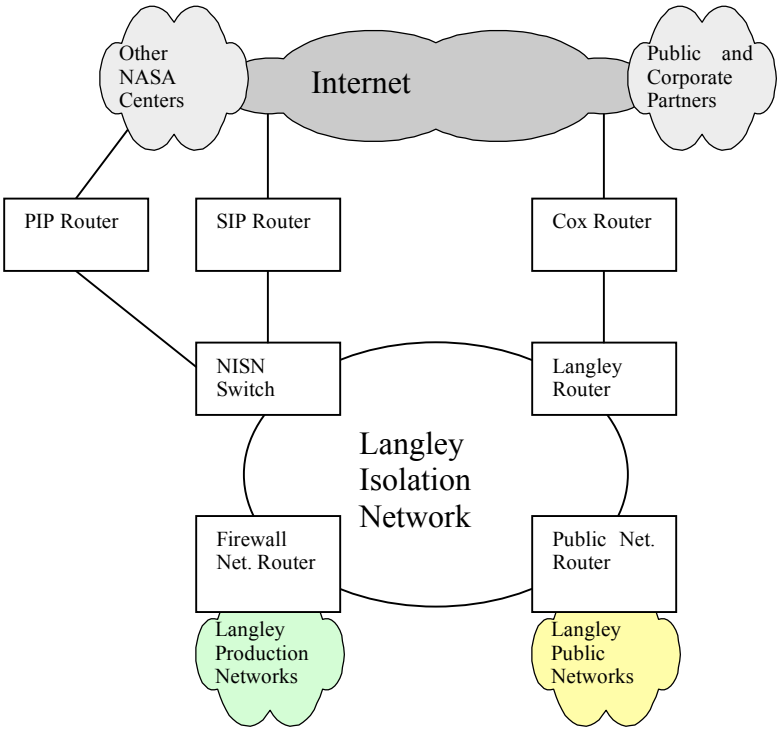
SSC:

- Commercial WAN provided by the Regional Bell Operating Company (RBOC)
- FTS WAN obtained from General Services Administration (GSA) FTS 2001 contract and the MCI carrier is the Center's WAN used primarily for domestic and international voice traffic, SSC Video Teleconferencing System (ViTS) room and other video teleconference systems used by Department of Defense (DoD). NASA FTS services are managed at Marshall Space Flight Center (MSFC).
- DSN WAN access is provided by a Primary Rate Interface (PRI) connection between SSC, terminated in the SSC PABX (Public Access Branch Exchange) and the Navy base at Gulfport, Mississippi. This service is funded by DoD and restricted to SSC DoD users.
-

9.6 Production Network Diagrams

Although specific details of implemented configurations may vary slightly, the Langley Isolation Network diagram presents the typical configuration at a high level.

Figure 9, LaRC LAN Producton Network Diagram



9.6.1 Systems and Support

Configuration and management of WAN systems may be performed by a Center-specific performance based contract service provider or may be performed by the Outsourced Desktop Initiative for NASA (ODIN) contract. Where ODIN provides the service, ODIN operates an on-site help desk that is manned from 6 a.m. to 6 p.m. during business days. It operates an off-site help desk 24 hours a day, 7 days a week. Cold spares are maintained for all network devices.

Security on the Isolation Network is provided either by the Center ODIN service provider or by the Center-specific performance based contract service provider. Security-related devices and services include, but are not limited to, firewalls, virtual private networks (VPNs), and intrusion detection systems.

9.6.2 Facilities

Wiring space is maintained for housing network infrastructure devices. Isolation Network facilities maintain proper environment and back-up power. Workspace is also provided to civil servants and contractors who maintain the network. This includes space for the local network operations center. In most instances the facility is provided as GFE to the contractor, whether ODIN or Center-specific contractor.

9.6.3 Compliance

All networking systems comply with NASA security policies such as NPD 2810.1. The systems support open standards and off-the-shelf products.

9.6.4 Capabilities

The WAN system supports many capabilities including:

- Ethernet, Fast Ethernet, and gigabit Ethernet connectivity
- FDDI connectivity
- Inter-Center connectivity
- Internet connectivity
- Routing for IP

The connectivity provided is enabling to essentially all core business functions of NASA.

9.7 Local Area Networks

9.7.1 Introduction

The NASA Center local area networks (LANs) utilize off-the-shelf products to provide standards based connectivity to research, support, and infrastructure devices.

9.7.2 As is Condition

Every Center network utilizes a combination of media that includes copper, fiber, and optical wireless. Specific configurations and breakdowns of types are captured in Center-specific documentation (Volume 2). All Centers provide nearly complete coverage of buildings at 10 Mbps, considerable coverage at 100 Mbps, and only a few Centers have significant 1000 Mbps coverage.

The primary media access technology is Ethernet with a small and decreasing percentage of Fiber Data Distributed Interface (FDDI). Most routable protocols are supported including Internet Protocol (IP), AppleTalk, DECNet, and Internetwork Packet Exchange (IPX). These allow for a wide array of applications that support the user's requirement for electronic messaging, data streaming, file sharing, and file storage.

All reporting Centers have indicated at least some level of concern over aging or outmoded equipment, although the levels of concern vary widely.

9.7.3 Systems Description and Operational Concept

The objectives of the Local Area Networking Component are to:

- maintain and assure the continuity of wired and wireless services to NASA customers;
- provide a reliable and accurate domain host naming, directory, and strong authentication services for the Center environment;
- ensure availability of deployed dial-in remote access services; and
- interface seamlessly with the network management services deployed for the Wide Area Networking Component.

Specific details of implementations entail large volumes of detailed data and vary considerably from Center to Center. In order to characterize typical implementations, we provide a high level description of only the Johnson Space Center (JSC) and Langley Research Center (LaRC) LANs. Most other Centers have comparable implementations.

JSC

The JSC Institutional Network is a local area network with a primary FDDI ring and several FDDI subnets connected by Cisco routers. The desktop workstations and servers tie to the network at concentrators. The FDDI campus backbone connects the JSC buildings with a 100 Mbps FDDI. The Backbone is currently being upgraded to a switched mesh Gigabit backbone. Currently about 1/3 of the buildings on site have been transitioned to the new backbone. The connectivity for the end workstations is also in transition. In legacy areas of the LAN workstations connect to the LAN with a 10 Mbps shared

connectivity. In the areas where the network has been modified workstations are connected to a 100Mbs switched mesh system.
The JSC network consists of 3 zones of protection. There are firewalls installed to separate the 3 zones. This architecture allows for the protection of core systems and at the same time allows for the required external connectivity.

Zone 1: is the internet, including the other NASA centers. Very few JSC resources reside in this zone. One example of a service that resides here is our External "public" web site. In fact, the public web site is completely outsourced and is off of our internal bandwidth and address space.

Zone 2: "the DMZ" is where many of our local contractors are connected. While the inner firewall protects JSC from these connections, the connections are not protected from one another. Before being connected here, each company has to acknowledge that they are not being provided security services and must protect themselves. In addition, zone2 contains a number of services that are accessed from the internet (the public, other centers, and/or local contractors). Access is usually restricted to specific services. "public" web sites and the PPTP tunnel services are examples.

Zone 3: is the internal network of the center. Most of the JSC resources reside here. Desktop workstations, e-mail servers, files servers are all resources that reside in this zone.

Other protected areas at JSC are contained within zone 3. These areas are of significant importance and/or criticality that they warrant protections above the protections provided by Zone 3. The Mission Control Center is a good example.

As part of the networking services, JSC operates a Windows 2000 Forest which is configured as the Center Master Authentication Domain. All systems users have a domain account and the ID is used to access most network resources at the center. The server resources are still a mix of Windows 2000 and Windows NT4.0.

LaRC

The core of LaRC LAN is the Ethernet backbone network. The backbone is based on four high performance routing switches that interconnect at 1 Gbps. The interconnections can be upgraded to 40 Gbps to meet future demands. The four switches are located strategically in order to distribute the data load and segment local data traffic. The core switches connect to distribution switches via gigabit Ethernet connections. The distribution switches exist primarily at the building level. These switches also act as access switches making the architecture a collapsed distribution/access design. The access level of the network is a combination of switched Ethernet at 10 and 100 Mbps and shared Ethernet 10 Mbps hubs. Aside from the Ethernet backbone, an FDDI backbone exists that connects into the Ethernet backbone. The FDDI backbone supports less than 4% of the total number of connections at Langley. Wide area connectivity is provided by several means. The NASA Integrated Services Network, NISN, and a commodity provider, Cox Communications, provide inter-Center and Internet connectivity. Short-haul connectivity to research partners is provided via Fast Ethernet, Ethernet, and T1. Dial-up

connectivity is provided via two ISDN PRI lines that allow 46 simultaneous connections. Client-to-Network VPN service is also available.

Four security zones are recognized. The "open" networks are those networks whose management is shared with Langley. These are high-risk connections that include Internet and Inter-Center connections. The "public/de-militarized zone (DMZ)" networks are those networks that are partially secure and are only somewhat more secure than the open networks. The "general production" networks are those that reside behind the Center's primary firewalls. These networks are considered low-risk and are where most devices reside. Finally, there are the special projects and wind tunnel networks. These networks either do not connect to the general production network or connect to the general production network via a dedicated firewall.

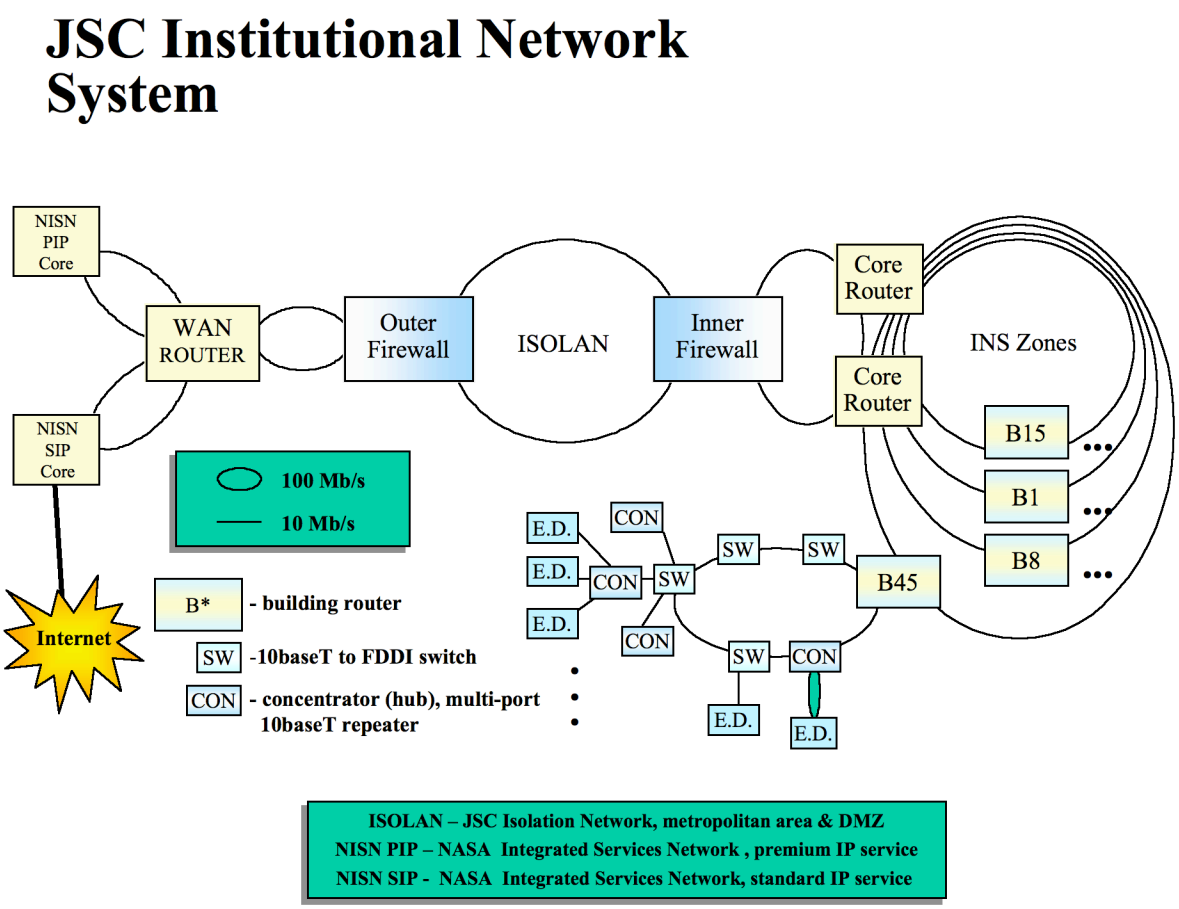
9.7.3.1 Wireless Network Concept

Several Centers have initial versions of Wireless Networks implemented. For example, the HQ wireless network consists of Cisco Aironet 350 Series Access points mounted in the ceiling on the 3rd, 5th, and 6th floors of the HQ Building. All access points are logically grouped on a single subnetwork within the Local Area Networking Component. Wireless clients are assigned non-routable IP addresses by a dynamic host configuration protocol (DHCP) server, and access either the HQ Intranet or the Internet through a designated firewall. Traffic to the HQ Intranet strongly authenticated using ACE/SecurID tokens and is permitted by a Cisco Virtual Private Network (VPN) Model 3080.

9.7.4 Production Network Diagrams

Figure 10 shows the high level JSC network architecture. The internal networks are on the right of the diagram and the WAN connectivity on the left.

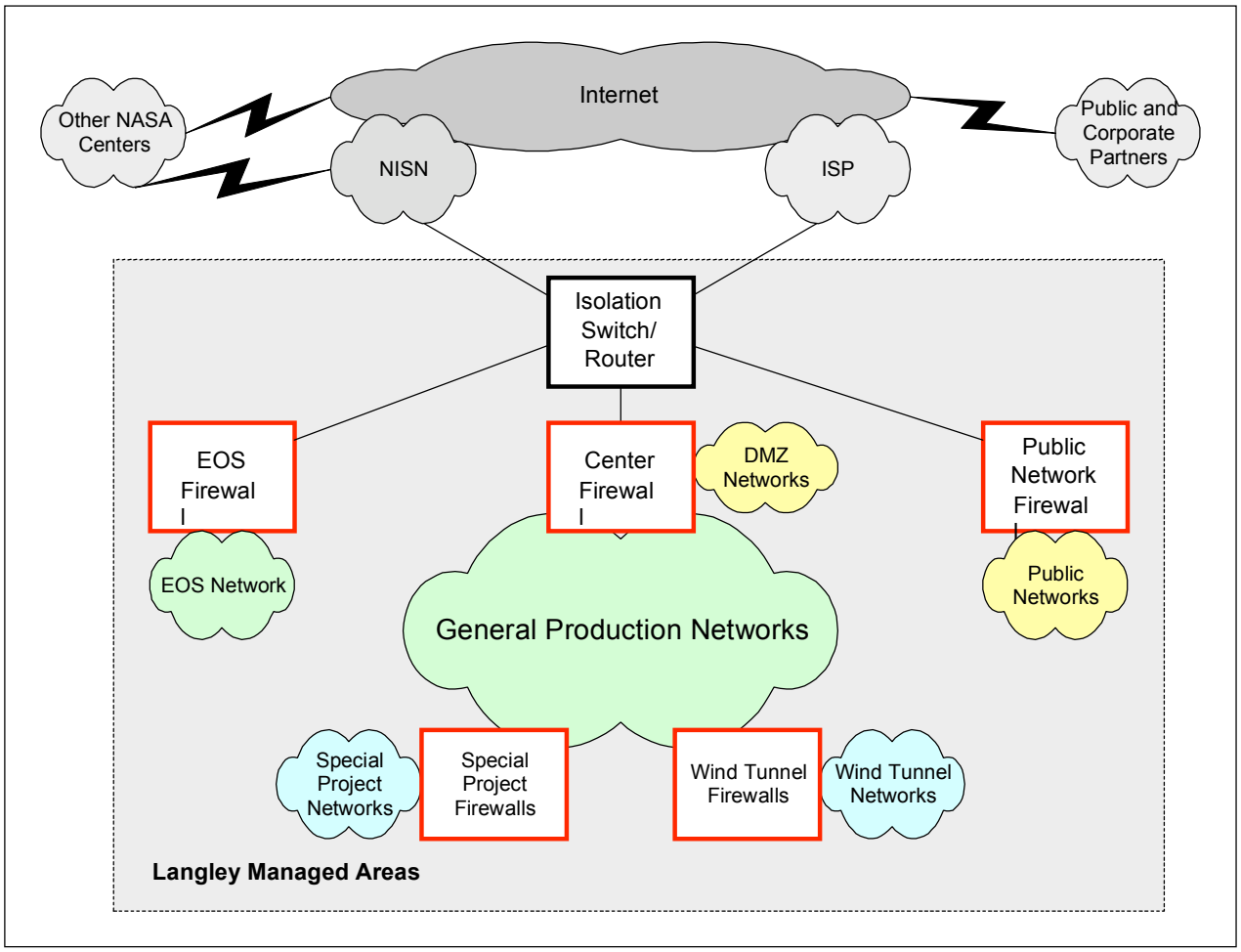
Figure 10, JSC Institutional Network System



9.7.4.1 The Langley General Network Diagram.

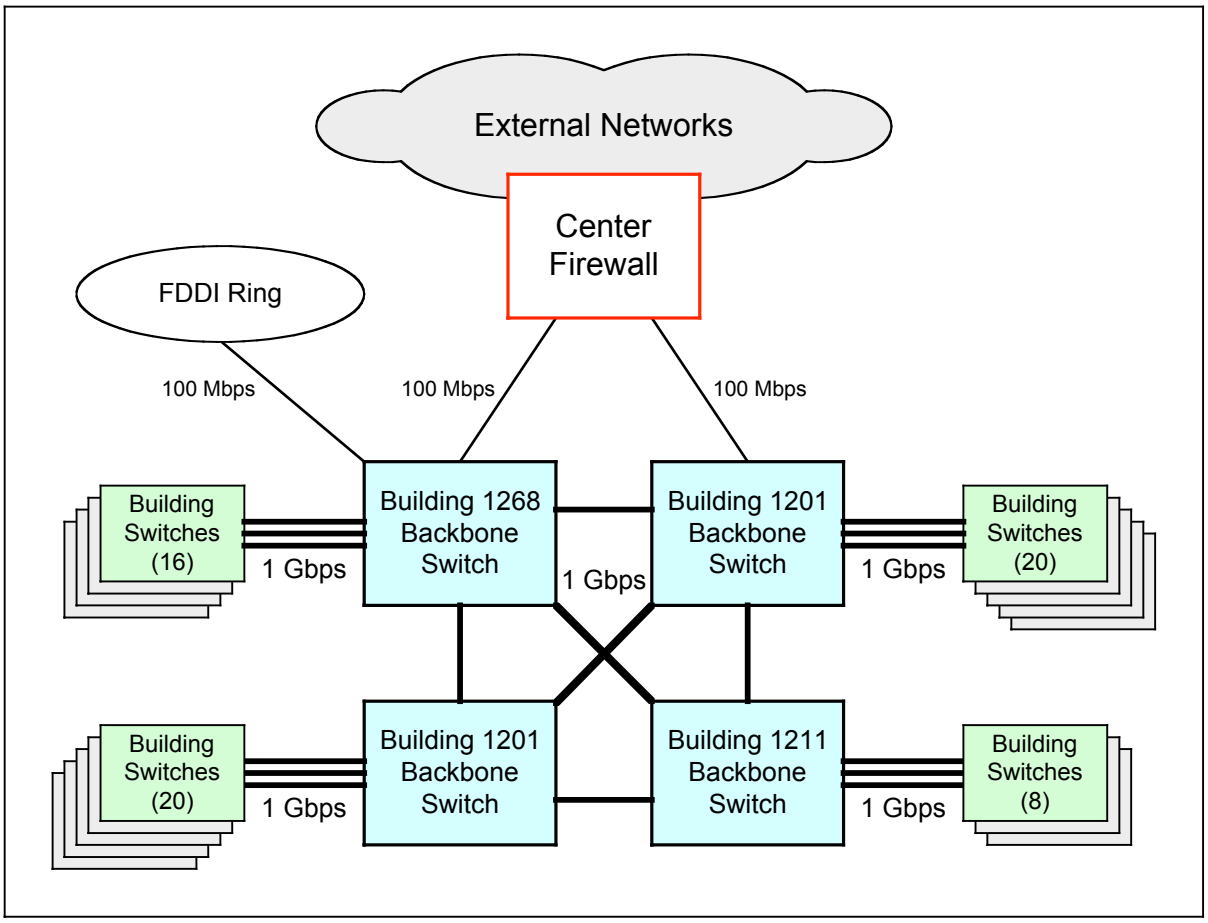
The Isolation Switch/Router is currently an FDDI ring. Target transition is July 2003.

Figure 11, LaRC General Network Diagram



9.7.4.2 The Langley Ethernet Backbone.

Figure 12, LaRC Ethernet Backbone



9.7.5 Systems and Support

Configuration and management of most of the Center LAN systems is performed by the Outsourced Desktop Initiative for NASA (ODIN) contract. ODIN operates an on-site help desk that is manned from 6 a.m. to 6 p.m. during business days. It operates an off-site help desk 24 hours a day, 7 days a week.

Some Centers, Kennedy Space Center for example, utilize the Consolidated Space Operations Contract (CSOC).

Other Centers, NASA Headquarters for example, utilize a Center-specific support contract vehicle..

There are a variety of other support systems for this Component; those systems include:

- The Help Desk
- Tier 2 & 3 support personnel
- Action Request Systems
- Dial-in Service
- SecurID authentication service

Contract and/or civil service staff support these functions.

9.7.6 Facilities

Wiring space is maintained for housing network infrastructure devices. Major wiring facilities maintain proper environment and back-up power. Workspace is also provided to civil servants and contractors who maintain the network. This includes space for the local network operations center.

9.7.7 Compliance

All networking systems comply with NASA security policies such as NPG 2810.1. Compliance with A-130 security is also required.

9.7.8 Capabilities

The Center LANs support many capabilities including:

- Ethernet, Fast Ethernet, and gigabit Ethernet connectivity
- FDDI connectivity
- Access to applications including office automation, electronic mail, World Wide Web, print services, file services, and remote access
- Dial-up network access
- VPN network access
- Inter-Center connectivity
- Internet connectivity
- Support for IP, AppleTalk, DECNet, and IPX
- User accounts
- User system configuration management and services

9.8 Voice Component

9.8.1 Introduction

9.8.2 As is Condition

This function provides voice services to users including hardware, software, services and communications that are not provided by NASA WANs. Examples are wireless pagers, cell phones, and local and long distance telephone services. Also included at some Centers are functions like Emergency Warning Systems, Public Address Systems, or special facility operations systems.

9.8.3 Systems description and Operational Concept

ARC provides the following services to authorized users:

- Operation and Maintenance of the Telephone Switching System
- Telephone Add/Move/Change/Repairs
- Voicemail Services
- Telephone Directory
- Operator Services
- Government Calling Cards
- Cellular Telephones
- Copper Cable Pair Assignments.

GSFC provides the following services to authorized users:

- Telephone switches at Greenbelt (GBLT) and Wallops locations access the local Verizon Central Offices to obtain access to local calling. Long distance, international calls and Voice Teleconferencing services are accessed through MCI which is an FTS-2001 Wide area service provided by NISN/Marshall Space Flight Center (MSFC).
- Cell Phones and pagers are acquired through several options. The customer may choose the ODIN desktop Contractor or an outside vendor.
- Facsimile machines formally were purchased and maintained by the NISN/MSFC. Effective FY04, customers will have the option of acquiring their own machines either through ODIN or an outside vendor.
- Toll free “800” services are acquired though NISN/MSFC.
- The operator attendants for both sites are located in GBLT.
- The two-way radio system contract at GBLT is managed by Code 290 and maintained by a contractor.

GRC provides the following services to authorized users:

- Telephone service.
- Public Address System.
- Operational and Emergency Intercom (O&EI) System
- Teleconferencing services.
- Trunked radio system.

Headquarters provides the following services to authorized users:

- Local ISDN (GSA WITS) phone service;
- Long distance (GSA FTS 2001) phone service;

- Incoming 800 service, provided by Verizon;
- Calling cards for 689 users, provided by MCI/WorldCom;
- Voice mail;
- Facsimile service to approximately 182 FAX machines;
- Verizon cell phone service, 375 users;
- Nextel cell phone service, 60 users, primarily in the area of safety and security;
- Nextel international cell phone service, 20 users;
- PBX for the HQ Help Desk, Avaya IP Office;
- PBX for the NASA Inspector General (IG), NEC 2000.

JPL provides the following services to authorized users:

- Local telephone service is SBC Centrex provided under the State of California CALNET contract
- Domestic and international long distance service is provided through FTS
- Voice mail is provided by SBC using the State of California CALNET contract
- Automatic Call Detectors and call routers use SBC Centrex based services
- Automatic Call Detector management functions are provided using Nortel's Call Center Management Information System (CCMIS)
- 800 number services are provided through FTS
- Calling card services are provided through FTS
- Facsimile equipment is purchased by JPL
- Teleconferencing services are provided using FTS VoTS and meet-me lines
- Data conferencing/teleconferencing services are provided using Latitude MeetingPlace
- JPL operator services are provided by SBC
- Cell phone service is primarily provided by Cingular using a GSA contract
- Other cell phone service providers are used as project and user requirements dictate
- Satellite phone service providers include the Department of Defense and Globalstar

JSC provides the following services to authorized users:

- Telephone service: local telephone service within the JSC facilities, including but not limited to, Ellington Field and Sonny Carter Test Facility, local outside line service, and long distance service. The service provides direct inward dialing.
- Voice mail service: voice mail service with password control
- Data service: inward and outward dialing from modem equipped computers and facsimile machines attached to analog subscriber lines.
- ISDN service is not provided to users although the system can support it.

KSC provides the following services to authorized users:

- Telephony
- voice messaging
- video conferencing
- low-speed data network services

MSFC provides the following services to authorized users:

- Telephones

- Cell Phones
- Pagers
- Radios

SSC provides the following services to authorized users:

- PABX services
- Voice Mail
- Facsimile services
- Telephones
- Radios
- Cell Phones
- Calling cards and 800 toll free service
- Voice teleconferencing
- Voice Over IP

9.8.4 Production Network Diagram

Production network diagrams vary widely and are contained in Volume *2.*

9.8.5 Systems and Support

At all centers the support is heavily outsourced or otherwise contracted and minimal government support is required.

ARC: Installed at ARC, is a Nortel Networks SL-100 SuperNode PBX, running at software level MSL-15. The primary host is located in Building N263, and two remote PBX switches are located in Buildings 17 and 780. These switches currently provide over 8,600 lines to NASA ARC and Moffett Complex end users. The host and remotes are connected via fiber. Voicemail is supplied by a 6-node Siemans Rolm Phonemail system. Call collection is provided by a Pollcat III system; and call detail processing/telephone management system is provided by Comware.

Carrier service is provided by 4 FTS PRI's; 8 DID/DOD PRI's and 1 DSN/Autovon T-1. PRI service connected to the SL-100 through a Secure Logix PBX Firewall. There are a total monthly average of 657,000 inbound and outbound trunk attempts. To support 911 calls to the on-site Security PSAP Office there are 3 CAMA trunks and a Telident System connected to the Host. The Voice Service Group, within the Network and Communications Branch (Code JTN), provides, either directly or as a customer liaison, all telephone services. The local Help Desk (IT Support Center) provides basic first tier support, then coordinates Remedy Trouble Tickets with the Voice Service Group. Issues related to FTS2000 are handled via the MSFC Trouble Desk. Telephone Add, Move and Change requests and Cellular Services are provided to end-users through a Demand Services type chargeback process.

MSFC

Telephones – Currently MSFC has InteCom S80+ telephone switch with approximately 12,000 active ports (i.e. analog and digital phones, fax machines, modems, etc.) MSFC is in the process of upgrading the switch to an EADS of North America PointSpan system. This system will be VoIP capable. The voice mail system that is attached to the switch is an Octel VMX 300 XL with approximately 7,000 active mailboxes. The MSFC voice mail system will need to be upgraded within the next 5 years.

Cell Phones – MSFC has two cell phone providers, Cingular and Corr Wireless. Cingular is the cell phone of choice for users that need cell service occasionally or require service mainly for travel. Corr Wireless can be used as a desktop replacement and is designed for users that are heavy users in the local area. Corr Wireless gives the users 5-digit dialing and FTS capabilities. Between the two providers, MSFC has approximately 800 users.

Pagers - MSFC utilizes both US Government owned paging services and Leased paging services. The US Government owned system consists of a central controller, a Radio Transmitter operating in the VHF region of the radio spectrum and approximately 600 pager units. There are five pager options (Standard Statewide Digital, Statewide Alpha, Nationwide Digital, Nationwide Standard 2-way, Nationwide Enhanced 2-way) available to users via MSFC's leased paging agreement with approximately 900 currently being leased.

Radios – MSFC has a Land Mobile Trunked Radio System. The system supports such activities as Maintenance Operations, Security, and Emergency Services. The Radio System provides Radio Communications in the 406 to 420 MHz portion of the radio frequency spectrum. MSFC has approximately 550 Portable radios, 25 Mobile Radios, and 15 Dispatch Radio

GSFC

The GBLT and WFF telecommunications systems are maintained and operated by the Siemens Enterprise Networks of Reston, Virginia. They provide maintenance on the installed systems on a preventive (scheduled) and remedial (routine and emergency call-out) basis. Additional installation services, normal day-to-day moves and changes, any new system design, testing and cutover of any required expansion shall also be provided as necessary. Response time for emergency remedial maintenance is 4 hours while non-emergency remedial maintenance response time is 24 hours.

GRC

In 1990, the Fujitsu F9600XL Telephone System was installed in NASA Glenn Research Center (GRC), building 15 (Edward R. Sharp Employee Center). The F9600XL is a multimedia platform PBX supporting such advanced technologies as Integrated Services Digital Networking (ISDN) public and private. The Public Address Systems at the Glenn Research Center (GRC) are comprised of five ITT 10A2 telephone key systems that provide intercom capability for all wind tunnel and support facilities. The Operational and Emergency Intercom (O&EI) System was installed at NASA Glenn Research Center in 1987. It provides one button dialing to all remote locations, the ability to connect up to eight telephones together by pressing one button and interface with the existing overhead paging systems in various buildings and locations. A state of the art, stand-alone conference system developed by Latitude Communications was installed in late 1996. The Trunked Radio System replaced all of the independent radio communication equipment and serves as the only authorized and licensed two-way

radio communication system at the Center. The Octel Overture 350 system provides Voice Messaging. Support and operations are provided by the ODIN contract.

Headquarters

Local voice mail services is provided by an Octel Overature 250. The Avaya supports 12 Help Desk agents. The NEC supports 14 NASA personnel. A staff of seven contractor personnel provides support to all HQ voice services.

JPL

JPL has minimal internal support requirements. The primary support functions are oversight of service providers and contractors. JPL personnel also handle planning and the engineering of new telephony based services.

JSC

Building 17, and room 134. This room contains the host EWSD™ switch and voice mail system along with the Main Distribution Frame (MDF) connecting to the Southwestern Bell Telephone Company (SWBT) trunks, to the Federal Telecommunications System (FTS) trunks via the National Aeronautics and Space Administration (NASA) NASA Integrated Services Network (NISN), and to the Satellite Distribution Frames (SDF) at the remote switch unit locations. Building 17 also contains the spares inventory.

KSC

A Siemens EWSD Class 5 Central Office with remotes in major buildings and an integrated Centigram Voice Mail system were installed at NASA KSC in 1999. The EWSD and its' remotes are DC powered and receives power from facilities located in or adjacent to each switch room. The Integrated Services Digital Network (ISDN) data feature of the EWSD provides the capability to transmit voice, data and video across the center and off center. The center has a Multi port Conferencing Unit (MCU) which is integrated with the EWSD to provide video conferencing to the center and other government entities, both over Primary Rate Interface (PRI) and Basic Rate Interface (BRI). Configuration and management of the KSC Telephone System is performed entirely by the Outsourced Desktop Initiative for NASA (ODIN) contract. ODIN operates an off-site help desk 24 hours a day, 7 days a week, and ODIN personnel also provide on-site technical support from 6am to 6pm on business days. The ODIN contract specifies 4-hour return-to-service for infrastructure components, and ODIN maintains a spares inventory of frequently used and major system components.

SSC

A Bell South wire center is located at SSC in the Communications Building to support requirements for SSC, the Mississippi Army Ammo Plant, and construction contractors located on the Center. SSC is served by an EADS North American, Inc. (EADS), PointSpan 6880 PABX switch upgraded from an Intecom IBX S80+ switch in July 2002. Ownership remains with NASA and is managed and operated under the ODIN contract. This switch serves all agencies at SSC under a reimbursable agreement with the various agencies and contractors located at the center. The Technical Services Contractor (TSC) is

responsible for all cost sorting and reimbursable reporting into the NASA Financial Management System. The EADS PointSpan system can migrate to VOIP in increments as funding and requirements dictate. SSC is served by an Octel 300 Serenade voice mail system. Ownership remains with NASA and the system is managed and operated under the ODIN contract. This system provides voice mail services for all agencies and contractors at SSC.

9.8.6 Facilities

All Centers provide any required facilities (computer rooms, training, offices) that are used to support the Voice component. However, since this component is heavily outsourced, facility requirements are generally minimal.

9.8.7 Compliance

The NASA Voice system complies with the policy and guidelines of the NASA Security requirements (NPG2810.1).
NASA also complies with the American with Disabilities Act (ADA) by supplying Telecommunications device for the deaf (TDD) devices when requested.

9.8.8 Capabilities

The voice component provides all voice communications services required to efficiently conduct the business of the Agency, including :

- Local, long distance, and international dialing;
- Voice Mail;
- Voice Conferencing;
- Facsimile services;
- Cell phone services.

9.9 Video Component

9.9.1 Introduction

Video services include Video Teleconferencing Systems (ViTS), digital video recording and production, video distribution systems, and video repositories. These video services may support multiple key mission responsibilities of NASA in addition to servicing general purpose communication functions.

NASA is charged to provide the highest quality operational support to the Office of Public Affairs and NASA’s programs as related to the Agency's statutory obligation to provide for the widest and most

practicable dissemination of information to the public. NASA Television operates as a primary distribution point for the majority of NASA's video to U.S. national and local media, international media, and other clients. In addition, video data and distribution is important to manned space mission operations, Earth and space science programs, and various aspects of technology programs. Finally, video distribution, videoconferencing and audio/visual capabilities are important contributors to automating or facilitating many general purpose functions such as meetings, conferences, and general employee communication. The mix of criticality and degree of functionality at each Center is dependent upon its particular mission role.

9.9.2 As is Condition

Every Center has one or more ViTS facilities with services provided through the NASA Integrated Services Network (NISN). Typical configurations are summarized below, but details are available only in Volume 2. NASA Video Teleconferencing Service (ViTS) is an Agency-Wide NISN provided service for video teleconferencing. ViTS provides interactive point-to-point and multipoint conferencing capabilities to NASA locations, selected contractor facilities, and public video conferencing services. ViTS is primarily based on circuit-switching technology, uses FTS-2001 services, and supports standard International Teleconferencing Union (ITU) H.320, H.263, G.722 and G.728 compression formats. NISN provided services include provisioning and maintaining special video conferencing rooms, scheduling of videoconferences, and the transmission and distribution of the video and audio among the participating locations. These services are described in more detail via the NISN Services Document (NSD). This document can be found online at WWW.NISN.NASA.GOV.

Audio/Visual services provide basic AV support of major meeting areas and conference areas within NASA Centers. Specific states of equipment age and capabilities vary widely and can be found in Volume 2.

Selected Centers have significant investments in video production. These include HQ, JSC, and SSC.

9.9.3 Systems Description and Operational Concept

Each Center has one or more rooms dedicated to ViTS function. Scheduling is done at an Agency level. Users request scheduling services from their local service provider, who then works to reserve the appropriate facilities. Primarily ViTS uses Polycom codecs to transform baseband audio and video into digital packets transported by ISDN lines. Each room typically has its own codec, associated ISDN lines, and one or more television cameras and an audio system. As required, some rooms also have additional equipment and capabilities. Detailed configurations are not presented here, but are generally available in Center descriptions in Volume 2.

Audio/Visual support is generally available from a shared services support contract provider, and may include set up, delivery and operations of equipment.

Centerwide Video distribution systems vary in implementation, with details available in individual Center descriptions. All, however, provide a basic broadband CATV type of service to all major buildings on their campus. Users can request service drops through their local service provider.

Significant Video production systems, where they exist, are described below.

HQ video production and distribution systems:

Production Control Room - PCR - (CA10):

Contains video switcher, camera controls, character generator, still store, intercom, and SCAMA circuits to support live and taped television programming.

Audio Production Control Room - ACR - (CA08):

Contains audio console, intercom, tele-hybrids, and an interface to the support audio circuit to support live and taped television programming.

Equipment Room - ER - (CE37):

Contains equipment frames, audio/video router, patch panels, and reference signal generating equipment that constitutes the 'heart' of the AVC. The audio/video router is a matrix router that enables point-to-point connection of equipment. Test stations are included for engineering monitoring and set-up. The Equipment Room also houses the automation and server system used to program NASA Television. The ER also has connectivity to the HQ Auditorium to support press briefings and other events.

Post Production Control Room – PPR - (CA30):

Contains video editing equipment, a character generator, a still store, and an audio console for editing programming that will air on NASA Television. SCAMA circuits are available to co-ordinate video feeds from other NASA Centers.

Media Recording – MR - (CB23):

Contains videotape recorders capable of providing multiple copies of Beta SP and VHS format video.

Graphics – GFX - (CA50):

Contains a computer system optimized to provide broadcast quality still graphics and animations.

Studio (CC25):

Contains a lighting grid with television lights and dimmer panel, an intercom system, and connectivity for three camera television productions.

Transmission Operations Center – TOC - (CE12):

Contains fiber transmission and reception equipment to send and receive programming for NASA Television. Also contains fiber interface to the Verizon Audio Video Operations Center (AVOC) that allows connectivity primarily to/from meeting rooms on Capitol Hill.

JSC video production and distribution systems:

BASEBAND TRANSMISSION NETWORK: The baseband video network is used to transport video and audio signals between JSC facilities for recording, distribution for viewing, or re-transmission to other facilities and external interfaces. Most signals are transmitted in an analog NTSC format over fiber optic cabling.

ROUTING: Routing of television signals is under control of the video operators in building 8 and building 2 who have control panels that select any input to any output, via interfaces to a control system. Complex routing operations can be pre-stored and executed under a few key strokes. Analog signals are routed in a baseband format, digital signals are routed using a different set of switchers and operate in an SDI (Serial Digital Interface) format, generally at the 270Mbs rate.

VIDEO DOWNLINK RECORDING/PLAYBACK SYSTEM (VDRPS): Used to record and replay ISS and Shuttle downlink video signals. Uses a hybrid of COTS digital betacam tape and MPEG 2 video server recording technology and the system is operated using a custom control system. The quantities have recordings have not yet necessitated employing an automated juke box type system for making the recordings.

VIDEO ASSET MANAGEMENT SYSTEM (VAMS): Used as a tool to catalog and describe the subject matter in downlinked and onboard ISS and Shuttle video, and publish it for searching at all NASA sites. The system makes a low resolution version of the video and makes it accessible, along with the catalog and metadata via a web interface at **http://jsc-isd-vid02.jsc.nasa.gov/screeningroom/**

SIGNAL VALIDATION AND ADJUSTMENT SYSTEM (SVAS): Technical control and switching hub for the television network. Includes distribution equipment, analog test equipment, confidence and display monitors. Operator call sign Johnson TV. The operators perform circuit validations and are in audio communication with the MCC-H and other NASA entities overseeing video.

TAPE DUPLICATION FACILITY (TDF): Used to produce high volume video tape copies of master recordings and PAO productions. Has a small capability to make DVD copies.

DIGITAL MASTERING SYSTEM (DMS): Used to master and edit video material in the digital domain. A modern design that can be expanded to include other digital formats as they been standardized. Editing of standard definition television material is done on hard drives (non linear) editing of high definition television is done on video tape. Migration to non-linear HD editing is not cost effective at this time. (All)

MASTER RECORD/PLAYBACK AREA MRPA: Used for processing spacecraft onboard video tapes returned by Shuttle and Soyuz vehicles, and performing master recordings of institutional activities. A redesign of this system is being planned to replace old unrepairable equipment and to make the area an efficient place to handle the onboard tapes. (This system and

area used to produce Shuttle downlink recordings as its prime function and that work is now performed in the VDRPS system). (All)

OMNI MICROWAVE: This system transmits four channels of television programming over the air-waves out to a radius of ten miles from JSC. (The antennas are on the roof of building 1). The radio frequency assignment for two of the channels has been reassigned by the FCC for satellite cell phone use and if the licensee in the Houston area decides to provide this service we will have to cease operations for two channels. ISD is investigating alternatives such as video over I/P for service to SCTF and Ellington Field. (All)

SATELLITE RECEPTION: ISD operates several satellite dishes that are available to receive programming transmitted in C and Ku-bands. No capability upgrades are envisioned for these systems. The dishes are steerable and require an aggressive PM work schedule and sometimes repair. (All)

TEST AND TRAINING FACILITIES: Test and training facilities operated primarily by the Engineering and Mission Operations directorates are equipped with video systems for monitoring and recording the facility test or training activities. All the systems are analog. the systems that are contain unique environments such as vacuum chambers and the NBL are custom designed. As subsystems and parts become obsolete replacements will be recommended. A sustaining engineering function is performed to maintain these systems to defer wholesale replacements. (All)

PAO/MEDIA DISTRIBUTION: JSC maintains a video interface with the video systems operated by PAO in building 2, and distribution of video signals to media interfaces next to building 9. When digital television is offered by NASA we expect to upgrade the media interface to be compatible. The NASA digital television working group is proposing a multi-channel distribution of NASA Television and other channels throughout the USA. ISD will be supporting these upgrades with digital transmission and interfaces.

MISSION CONTROL CENTER (MCC): A significant baseband analog and digital interface exists between the Video Control Center in building 8 and the MCC. This interface is being transitioned to a digital interface as the spacecraft signals move to digital. A small capability to transmit HDTV at JSC is being planned in conjunction with an HDTV downlink capability being planned for the ISS (STS-114 is slated for the delivery of this system). (SSP/ISSP)

KSC

Photographic Services - Provides still and motion picture film image acquisition and processing for KSC/Shuttle and CCAFS customers, and provides photographic and optical equipment maintenance and repair to NASA and CCAFS participating customers.

Television Services - Provides the live and recorded video feeds that support launch and landing activities, shuttle processing, payloads processing, ISS and cable TV distribution to KSC Users, Customers, and the Media for Public Release.

Timing Services - Provides timing synchronization and count down (T&CD) information to operational users through out KSC.

SSC

Video and audio acquisition includes both studio and on location capabilities. Video can be captured digitally on the D-9 and Mini Digital Video (DV) formats or on analog formats such as Beta-SP, S-VHS, and VHS. The D-9 format utilizes the 4:2:2 component digital processing and is upgradeable to High Definition video.

Equipment includes five digital cameras and three analog cameras and accessories. A fully equipped studio with teleprompting, blue screen, and track lighting is also available. For live productions, a portable audio mixing, video switching, and lighting system is available.

Audio capabilities include a recording booth for narration and a full assortment of wireless and wired microphones including booms, lavalieres, podium, and PZM microphone.

The production facilities include a digital/component linear editing system and two non-linear editing systems, two DVD authoring stations, DVD duplicator, VHS tape duplicator, an open/closed captioning and sub-titling system, and a streaming video production system.

The non-linear editing systems are a Cinewave/Final Cut Pro system and an Avid Express Deluxe. The Cinewave uses the Final Cut Pro software for editing. It delivers real time uncompressed video and is upgradeable to HD. Other software includes DVD Studio Pro, Boris RED and Photo Shop 7.0.
The Avid system has 2:1 capabilities and includes Boris FX and Photo Shop 7.0 graphics packages. It is linked to a Pioneer DVD authoring system using Author Quick software.

The digital/component editing systems offers A-B roll editing capabilities through a Ecolab digital/component switcher. It is capable of doing A-B roll editing from either digital or analog inputs and can output to digital or analog tape formats. It can control up to seven machines at one time and includes Inscriber Supreme as a Character Generator (CG) and Pinnacle Genie as a DVE (Digital Video Editor). It is connected to a Pioneer DVD authoring system and a VHS tape duplicator capable of twelve copies at a time.

The department also has a stand-alone DVD/CD duplicator for multiple duplication.

Final deliverable products include digital and analog videotapes, DVDs, and CD-ROMs (both audio and video).

A videotape archive is maintained with tapes dating back to 1986.

9.9.4 Production Network Diagram

Production network diagrams vary substantially from Center to Center depending upon mission requirements and details are available only in Volume 2.

9.9.5 Systems and Support

NISN provides NASA with its video teleconferencing services. NISN requires MSFC to provide a services coordinator for their video conferencing rooms. This coordinator is the single local point of contact to schedule a video teleconference and to schedule any other use of the video conferencing facilities. To perform their scheduling tasks, services coordinators require specific equipment, system accounts and forms.

9.9.6 Facilities

Specific facility information varies widely depending upon the Center. Details are reserved for Volume 2.

The coaxial cable system within buildings is subject to being tampered with by users who connect unauthorized TVs to the LaRC TV system. Unauthorized connections often cause interference and a drop in signal levels to other TVs on the system.

9.9.7 Compliance

Video facilities are generally compliant with:

NASA STD 2818
SMPTE 170M
SMPTE 296M
Federal Communication Commission (FCC) regulations
Electronic Industries Association (EIA)
Society of Motion Picture and Television Engineers (SMPTE) standards
National Television Standards Commission (NTSC) standards
National Cable Television Association (NCTA) standards
Advanced Television Standards Commission (ATSC)
NPG 1620.1 NASA SECURITY HANDBOOK
NPG 2810.1 SECURITY OF INFORMATION TECHNOLOGY
NMI 1450.11 NASA MAIL MANAGEMENT PROGRAM

9.9.8 Capabilities

The NASA ViTS is a video teleconferencing service providing interactive point-to-point and multipoint conferencing capabilities to NASA locations, selected contractor facilities, and public video conferencing services. ViTS supports point-to-point calls ranging from 128 Kbps to 1,472 Kbps and NISN Video Bridge assisted multipoint calls ranging from 128 Kbps to 768 Kbps. The ViTS services include provisioning and maintaining special video conferencing rooms, scheduling of

videoconferences, and the transmission and distribution of the video and audio among the participating locations.

Each NASA Center supports a Centerwide Cable Television system that permits users to view selected channels, custom programming and selected playback services depending on the specific Center. Single Channel and Multi-Channel services are provided depending on availability to user location. Additionally, installation, relocation, and maintenance support for Cable Television sets and VCR's is provided to fulfill customer requirements. A majority of key building locations at each Center is equipped with broadband CATV service supporting user access to supported channels.

Centers whose role in the NASA mission call for it have the capability to capture and/or produce professional quality videos for scientific, engineering, or public consumption. This supports NASA in its mission to broadly disseminate its information and educate the Nation's youth.

9.10 Messaging and Collaboration Services

9.10.1 Introduction

This component provides e-mail, instant messaging and various collaborative tools to NASA employees to improve the ability to work together and coordinate with NASA partners across all disciplines.

9.10.2 As is Condition

Elements of this collection of services are in different states of standardization and maturity. E-mail is highly standardized and interoperable across the Agency. Instant messaging is not standardized, and is only available in pilot modes in general. A calendar function has been required at the desktop, but due to product incompatibilities and incomplete requirements, no Agency-wide service has yet been established. There have been multiple pilot implementations of various collaborative tools at most Centers, but only recently has a standard implementation of Team Collaboration been piloted with a commitment to move to NASA-wide production in the near future.

E-mail:

E-mail standard clients are specified in NASA Standard 2804, Minimum Interoperability Software Suite for PC, Mac and UNIX desktops. E-mail is governed by the following standards:

- The *NASA Electronic Messaging Architecture, Standards and Products* (NASA-STD-2815) defines an architecture for the design, implementation and operation of Electronic Messaging for NASA. This document established the following fundamental architectural definitions for Agency messaging:
    - A Simple Mail Transfer Protocol (SMTP) backbone
    - Multipurpose Internet Mail Extensions (MIME) attachment interoperability

- A client centric implementation; suggests the use of the Post Office Protocol (POP) or the Internet Messaging Access Protocol (IMAP)
- Use of the Client/Server model and Transmission Control Protocol/Internet Protocol (TCP/IP)
- The elimination of file based mail systems and gateways
- A continued commitment to X.500

- The *NASA Interoperability Profile for NASA E-mail Clients* (NASA-STD-2808A) defines the list of E-mail interoperability interface requirements for the Agency-wide electronic messaging system. This document established the following mandatory, preferred, and optional requirements for clients, servers, and gateways (only those relevant to this document are listed):
    - Simple Mail Transfer Protocol (SMTP) header integrity (mandatory); requires support for SMTP protocols and message formats (STD 10 and STD 11) as well as retention of all headers and respect of all standards-defined headers
    - Domain Name Service (DNS) support (mandatory); support correct E-mail routing via the DNS (RFC 1034 and RFC 974) or fully delegate to a component that does (includes proper support of "MX" records).
    - Multipurpose Internet Mail Extensions (MIME) support (mandatory); establishes minimum MIME requirements (RFC 1521, Appendix B) as well as specifying the supported registered MIME types.

- The *NASA Directory Service Architecture, Standards, and Products* (NASA-STD-2807C) defines all aspects of directory services involving mission-related, general-purpose, research, administrative and scientific computing, and networking throughout the Agency. It established the following fundamental architectural definitions for Agency directory services (only those relevant to this document are listed):
    - Requires that NASA maintain a distributed, Center-based, X.500 directory hierarchy; Center X.500 name space must be the *authoritative* repository for the relative distinguished name (RDN) that is bound to Center civil servant and contractor end-user identities.
    - Requires the NASA Directory Service to provide an email address "reflector" service that enables the simplified NASA SMTP email address in the form of "firstname.lastname@site.nasa.gov".

Other functions supported at essentially all Centers are:

PKI (Public Key Infrastructure) services integrated with Center email services
A centralized mailing list service (Majordomo).
SPAM filtering services.
Virus checking services.

Collaborative Tools:

In 2002, the NASA CIO provided funding to support the Team Collaboration Pilot. This pilot focuses on products to support virtual team meetings and spaces. The key objective of the pilot is to assess the

value of tools as applied to NASA team. The core business drivers include: enable work to get done with less reliance on travel; enable collaboration across NASA centers and external partners.

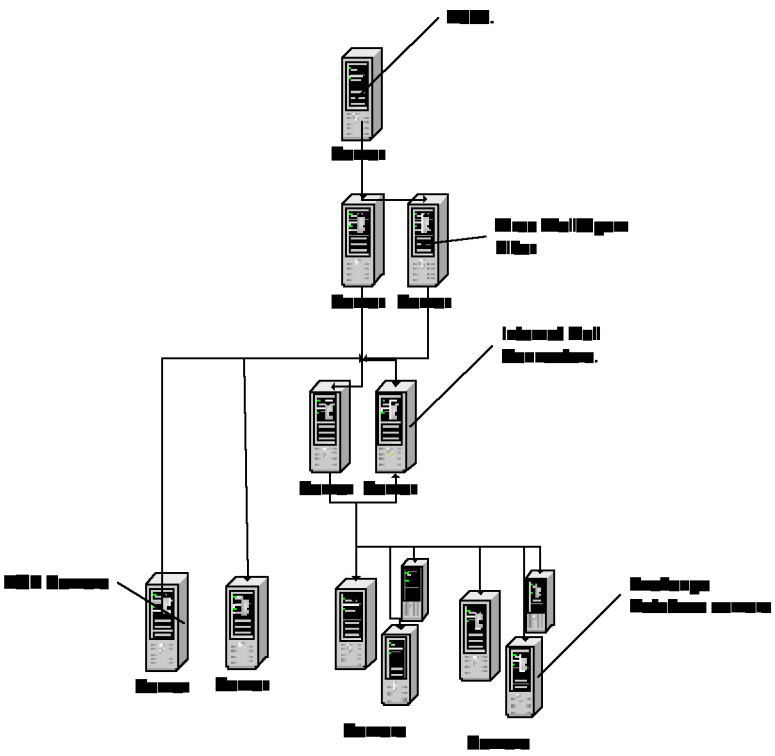
Prior to that time Centers had implemented locally some subset of tools such as Latitude Meeting Place, LiveLink, WebEx, e-Room, and various versions of custom developed applications to provide some of these functions.

9.10.3 Systems Description and Operational Concept

9.10.3.1 E-mail

E-mail Center implementation specifics vary and may be found in the individual Center descriptions. However, the high level description for the Marshall Space Flight Center provides a close approximation to that existing at every Center.

Figure 13, MSFC Email System Diagram



Inbound mail is delivered to the X.500 system though a firewall. The X.500 system then delivers the mail to the virus wall/spam filter, where it is checked for viruses and spam. The virus wall then does a lookup in the DNS to find which server to deliver the mail. If an MX record exists for a mail system at MSFC, the mail is delivered. If no MX record is found, the mail is returned to the sender as No Host Found. The POP servers are msfcmail.msfc.nasa.gov and msfcmail1.msfc.nasa.gov. The exchange system is msg.msfc.nasa.gov. The DNS round robin is used to load balance between the 2 Exchange IMS servers. The Exchange IMS computers then deliver mail to the exchange system and individual mailboxes.

Outbound mail is delivered to the X.500 system. Mail bound for other MSFC systems is treated as inbound mail. Mail directed to non-MSFC mail systems is delivered to the internet via MX records in the DNS. Again, if no MX record is found, the mail is returned to the sender. If the X.500 system is unable to contact the server defined by the MX record, the connection times out after 16 hours, and the mail is returned to the sender.

9.10.3.2 Collaborative Tools:

The Collaboration Pilot has been in operation approximately one year. There are 56 pilot teams (~700 people) supported, spanning all NASA enterprises/centers and some external partners. These pilot efforts are provided via an external Application Service Provider and offer the following functionalities:

Pilot for Virtual Team Meetings Software Product, WebEx Meeting Center
- Data conferencing: presentations, application sharing, desktop sharing
- Real time polling, meeting recording, integration with voice conferencing
- Simple scheduling and attendance via Web browsers, WebEx plugin, and email

Pilot for Virtual Team Space Software Product, eRoom
- Shared space for working files and discussions
- Process support: action item lists, routing buttons, team calendar, voting, polling
- Simple access via Web browser; optional plug-in for Windows convenience features (drag and drop)

Since the Collaboration Pilot is provided via Application Service Providers, there are no systems descriptions, no hardware or software configurations and no facilities or operational aspects to describe.

9.10.4 Production Network Diagram

Production network diagrams for Centers can be found in individual Center descriptions in Volume 2.

9.10.5 Systems and Support

The Outsourced Desktop Initiative for NASA (ODIN) contract performs configuration and management of the Email system at each Center. ODIN operates an on-site help desk that is manned from 6 a.m. to 6 p.m. during business days. It operates an off-site help desk 24 hours a day, 7 days a week. For the message store, there is disk mirroring with a hot standby to ensure minimal loss of data in case of failure.

9.10.6 Facilities

At most Centers the service primarily utilizes servers and communications equipment located in the Data Center as well as the Center LAN.

9.10.7 Compliance

Center email and collaborative services are consistent with the following agency standards:
- NASA-STD-2810 – UNIX Interoperability Standards
- NASA-STD-2804 – Minimum Interoperability Software Suite
- NASA-STD-2820 – Encryption and Digital Signature Standards

- NASA-STD-2807C - The NASA Directory Service -Architecture, Standards, and Products
- NASA-STD 2808A - Interoperability Profile for NASA E-Mail Clients
- NASA-STD-2815 - *NASA Electronic Messaging Architecture, Standards and Products*

9.10.8 Capabilities

All NASA employees currently have access to electronic mail, enabling them to communicate rapidly and efficiently with any other employee of the agency and with virtually any user on the Internet.

The Email System supports many capabilities (not all capabilities available at all Centers)

- Directory look up services such as: Fuzzy lookup, ph server, finger server, and whois server.
- Web access to directory
- Alias Lists – static, automated, and dynamic
- Webmail access
- Changes to user account using a web interface.
- Auto forward
- Support password changes from within POP client
- Single message size limit of 32 megabytes
- Remote access
- Import personnel data
- Backup/Restore individual mailbox
- Backup/Restore programming and system logs
- Password grooming
- Automated load balancing
- Ability to block spam
- Ensured delivery, troubleshooting logging
- System monitoring

9.11 Public Web Services

9.11.1 Introduction

This component includes Center and agency-wide development and hosting services focused on providing web access for the public to information about NASA – whether for business opportunities, for general public awareness, for educational purposes, or for dissemination of knowledge gained from NASA research and operations. Currently there is little overall organization or structure to this vast information resource. However, NASA has deployed an initial version of a OneNASA Portal which is intended to begin to provide the public with a single point of entry to NASA's web environment, providing the audience with an easy way to navigate through NASA's public web content without knowledge of NASA's organizational structure.

9.11.2 As is Condition

Publicly accessible web sites in NASA are currently hosted on a combination of central and distributed servers. The bulk of distributed servers are to provide mission-specific data or information. The bulk of general purpose information for the general public is hosted on central servers at the centers. Each Center, as well as NASA Headquarters, may have hundreds of accessible websites which provide various kinds of information.

A central web services function exists at ARC to support the Center's management of websites. There are roughly 300 registered, specific websites at the Center. The Web Services staff includes the ARC Webmaster and technical support staff to administer the function. Technical functions include website hosting, management, development, and curation of websites. The Web Services function also manages NASA policy implementation and support, and policing of websites including the web registration and tracking process that insures 508, COPPA, export control, and security compliance.

Glenn is currently in the middle of a migration process from a largely distributed web space outside the firewall to a compartmentalized web space with servers and services both inside and outside the firewall. The service is part of an integrated web architecture that runs/will run on 3 servers captured in the Data Center component. One server is used for internal web services, one server as a dedicated development environment, and one server on the Glenn External Services Network outside the Glenn Firewall. The server outside the firewall currently services both public and NASA-domain only traffic.

GSFC Public Web services consist of those Web Sites or applications that are designed for the purpose of public outreach. They do not include science or mission related Web sites. At GSFC, public Web services include the Center and Facility home pages:

- www.gsfc.nasa.gov
- www.giss.nasa.gov
- www.ivv.nasa.gov
- www.wff.nasa.gov

The purpose of the Center and Facility Home Pages is to provide general information about the Center and news and feature articles on various topics of interest to the general public.

The JSC public web services are made up of several distributed web servers both internal and external to the JSC Institutional Network external boundary. The humanspaceflight.gov web site is currently housed by an outsourced service through PSINet (recently purchased by Cogent). The JSC public Unix web server (Vesuvius) is known as www.jsc.nasa.gov, vesuvius.jsc.nasa.gov and listserv.jsc.nasa.gov. Vesuvius is the true hostname; all others are alias names. The system provides two public services, which are SMTP and HTTP. Private services for contractors and/or NASA employees are FTP, telnet and SSH.

MSFC sites provide the public with information about NASA and NASA projects. These websites are in all stages of completion, from concept to published. New customers are constantly requesting services, and are served in a timely and efficient manner. All new materials, whether a new site or content added to an existing site, are reviewed and approved as complying with all Federal, NASA, and

MSFC rules and regulations. Published sites are being reviewed for full compliance as a part of normal maintenance activities.

The majority of SSC's public web sites are located in the Stennis Data Center. These web sites are fully available to the public at all times. They have been registered, are compliant with all policies and guidelines (including Section 508), and have appropriate IT Security measures in place. These websites are indexed on the SSC Webmaster site, which can be accessed through the internal homepage, and this particular site provides both the URL address as well as the appropriate Responsible NASA Official for each. Public Web Sites must be registered and will undergo a review for security clearance prior posting. The SSC Web Site Registration form (SSC-707) must be completed and submitted to initiate the process of ensuring that the site adheres to all applicable policies and guidelines.

9.11.3 Systems Description and Operational Concept

Hosting of web sites includes provision of:

- Server Space
- Account Management
- Network Access
- Backup and Recovery
- IT Security
- Server Administration
- Software License Maintenance and Management
- Hardware Maintenance and Management

Website development is usually provided for by the Center central IT services organization, however other website development work typically takes place within programs, projects and line organizations, and may not be centrally provided.

Typical of several centers, Glenn Central Web Services provisions both the public web and many components of the internal web. There are separate development and production environments. There is an established automated publish process that moves content from a staging environment on the development system to either the internal or public server as appropriate. The development environment is currently provided with some tools such as WebLint (an HTML validator) and WebAlizer (log analysis).

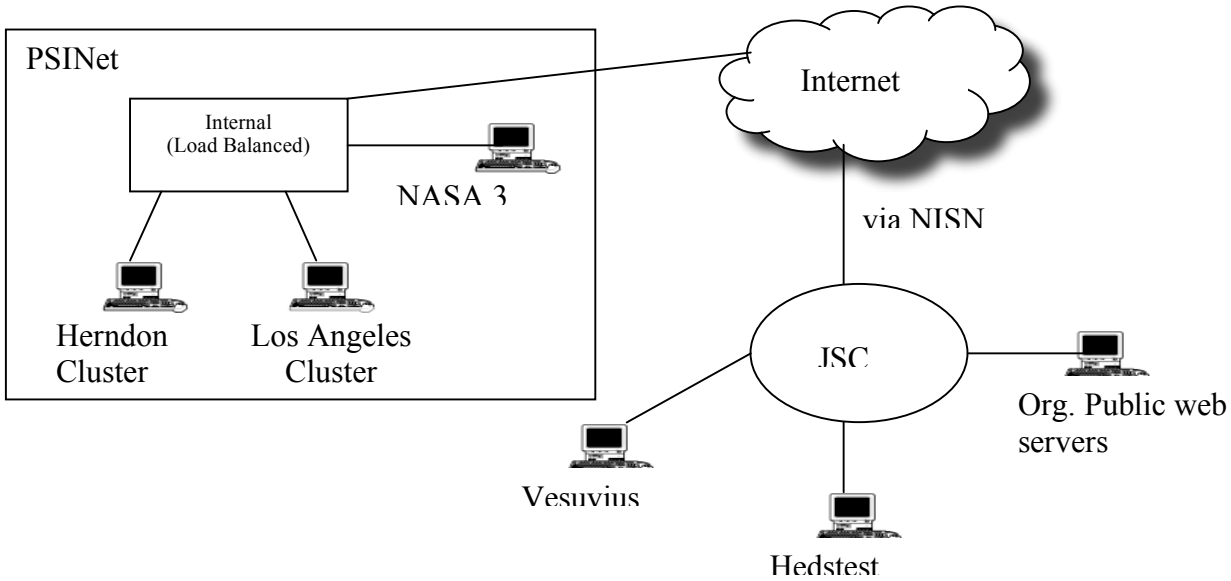
Public Web Sites MUST be registered and approved prior to deployment. This includes security considerations as well as accessibility and other considerations.

JSC

IMPASS Web Developers maintain two Web sites, the Human Space Flight Web (HSF), hosted by PSINet, and the external JSC Web, hosted on a local JSC server.

Figure 15 illustrates the general architecture of the hardware that makes up the development, staging, and production environments of the HSF and JSC external Web sites.

Figure 14, JSC Public Web Network Web



A three-stage approach is used for publishing content to the Human Space Flight Web. First, new pages are developed on a local JSC server maintained by IMPASS. Once pages are complete, reviewed, and approved, they are uploaded to an off-site staging server owned and maintained by PSINet, where they are tested a second time. Finally, updates to site content are automatically propagated by software provided by PSINet, to four off-site PSINet production servers, where they are accessible to the public.

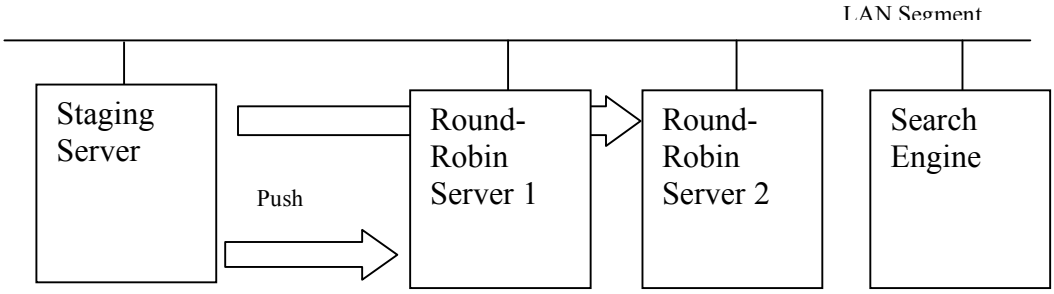
The development environment for both the HSF and JSC sites is located on HEDSTEST (HEDSTEST.JSC.NASA.GOV), a Sun Ultra Enterprise 450 running Solaris 2.7, located in JSC Building 46. HSF developers interact directly with this server through a utility that serves UNIX file systems to NT networks. An Apache Web server runs on this server, and has a virtual machine defined for the local copy of the site, so work in progress can be tested directly from the development server.

PSINet provides access via FTP and TELNET to a staging server offsite, an HP server running HP-Unix. This server mirrors the configuration of the production (public) servers. Every 15 minutes, an automated propagation script on the staging server distributes any additions, deletions, or changes to content to the production servers. The staging server is the only PSINet server to which HSF developers have direct access via FTP or TELNET.

JPL:
One staging server; 2 round-robin servers; one search engine server. The round robins systems consist of two Sun Enterprise 220R servers. Each E-220R is equipped with dual, 450MHz Sun UltraSparc II CPU's and 512Mbytes RAM. The staging server is a Sun Ultra-1 which consists of a single 167MHz Sun UltraSparc with 320Mbytes RAM. The search engine also runs on an Ultra-1 system with similar configuration as that on the staging server.

Web Contents - All web contents are first published on the staging server that restricts access only to JPL internal networks. The contents are pushed out to the two round robin servers on a regular basis. No users are allowed to access the round-robin servers.

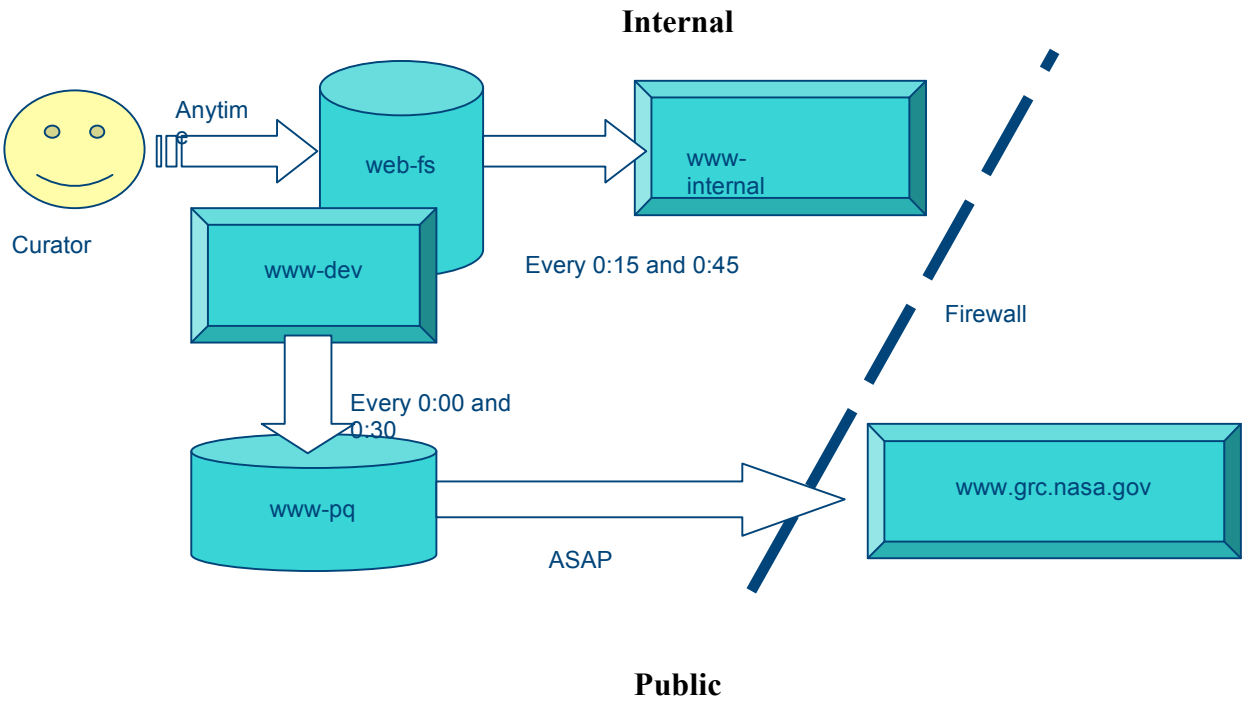
Figure 15, Network/Functional Flow Diagram



9.11.4 Production Network Diagram

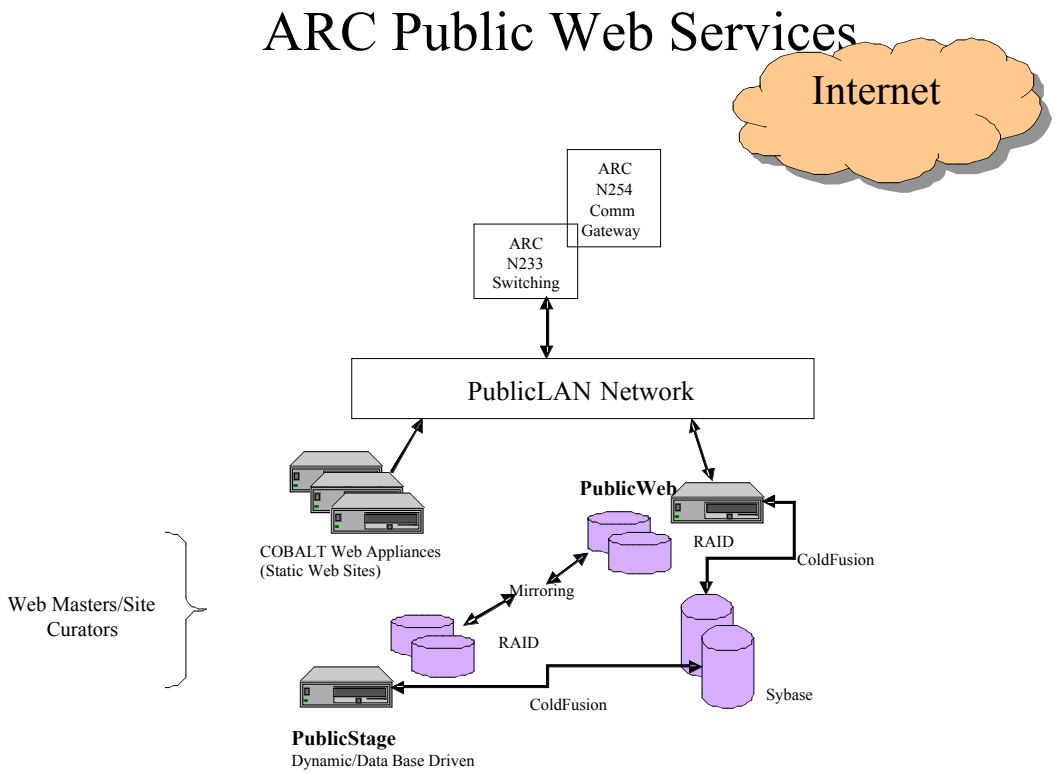
This diagram actually depicts both the general configuration as well as the push process for publishing updated content at GRC.

Figure 16, GRC Public Web Production Network Diagram



This diagram shows the connectivity of the ARC Public Web Services to the networks.

Figure 17, ARC Public Web Services



9.11.5 Systems and Support

The ODIN contract includes a provision for a Web services seat. Thus, many public web servers are serviced by ODIN. However, customers who wish to publish to the Internet are currently able to provide their own services in most instances as long as they comply with security, accessibility and other policy.

The ARC servers for this service consist of a production web server, a staging server, and a database server for centrally hosted and managed websites as well as a dozen low-end Sun Cobalt appliance servers made available to Center staff for hosting of end-user managed websites.

Production Web Servers:	1 x Sun 280R
	13 x Sun Cobalt RAQ4
Staging server:	Sun Ultra 1
Web Database system:	Sun E3000

SSC

The primary SSC public web site is hosted on Linux Operating System, which resides in the SDC.

Additional organization sponsored public web sites are hosted on Windows 2000 Operating Systems and Linux Operating Systems.

9.11.6 Facilities

The most common situation is that the web servers run in the Data Center at the respective Centers. If the server is customer supported, it usually runs at the customer location.

9.11.7 Compliance

Compliance with security and accessibility requirements are monitored for all public web sites.

9.11.8 Capabilities

The Public Web Services component enables NASA to provide general information to the public such as:

- News Articles
- Information on upcoming events
- Press Releases
- Images & Multimedia
- Media Information
- Information about the center

- Information about doing business with the Center
- Maps & Directions

10 Program Unique and Multi-Program/Project Portfolio Elements – Summary Descriptions

10.1 Program Unique Mission IT

10.1.1 GSFC - Hubble Space Telescope Mission Ops IT

The Hubble Space Telescope has been in an operations phase since launched on April 24, 1990. Four successful servicing missions have made dramatic improvements in the telescope. The planned investment is to keep the system functioning smoothly through the remainder of the Hubble Space Telescope mission. All funding for the Hubble Space Telescope comes from NASA, which is fully responsible for the maintenance of the satellite. The Hubble Space Telescope is unmatched by any ground based or space borne observatory. The demand for Hubble Space Telescope observing time by the worldwide science community is increasing. The Hubble Space Telescope Project is in the Operations phase of NASA IT Capital Planning and Investment Control (CPIC) process, and this IT investment is managed as a component of the NASA Project under NASA's NPG 7120 process.

The HST Program is re-assessing program plans due to the cancellation of Servicing Mission 4 on January 16, 2004. Development of the Cosmic Origins Spectrograph is complete. Wide Field Camera 3 (WFC3) development continues on the existing plan.

10.1.2 JSC Software Development/Integration Laboratory

The International Space Station (ISS) prime contract was awarded in 1993 to Boeing as a performance based contract for the total integrated design, development, manufacture, and integration of the U.S. On-Orbit Segment (USOS) of the ISS. As such, Boeing is responsible for integrating all ISS systems and subsystems such as the Command and Data Handling (C&DH) subsystem, including International Partner/Participant (IP/P) elements which interface with the USOS, government furnished equipment (GFE) developed by other contractors and provided to Boeing, providing ground support equipment (GSE), and providing technical support for ground and orbital operations. The Software Development and Integration Laboratory (SDIL)/Avionics is the command and data handling (C&DH) subsystem utilizing the onboard computer and network capabilities of the ISS. It also includes the ground support and test functions for the associated ground operations and sustaining engineering. As such, this "project" supports the International Space Station. The C&DH functions executed using the onboard computer and network capabilities are an embedded technical subsystem of the ISS spacecraft vehicle. The C&DH subsystem is a critical subsystem of the ISS, providing the essential capabilities to perform guidance, navigation, and control commands to keep the ISS in orbit, and to handle critical on-orbit activities, such as power distribution, crew housekeeping activities, and research and science experiments in the laboratory module.

10.1.3 JSC Space Shuttle Program Cockpit Avionics Upgrade

Need text

10.1.4 JSC Space Shuttle Program Flight Software

The Space Shuttle program plays a vital role in enabling NASA's vision and mission. This includes advancing human exploration and providing safe access to space in support of human operations in low-earth orbit. In order to maintain a viable human transportation capability that will operate and support NASA's launch requirements, specific program investments are required. NASA is revamping its approach to selecting and managing these investments to ensure Shuttle operability into the next decade and avoid future project overruns. These investments will be consistent with NASA's strategy of ensuring the Space Shuttle remains viable until a new transportation system is operational. These projects will provide revitalization of the infrastructure, and combat obsolescence of vehicle, ground systems, and facilities.

The Flight Software Element (FSW) is responsible for the maintenance, testing, reconfiguration and configuration management of the Onboard Shuttle Software. Execution of these responsibilities is accomplished by several teams within FSW: the Shuttle Avionics Integration Lab (SAIL), the Primary Avionics Software System (PASS), the Backup Flight System (BFS), the Multifunction Electronic Display System (MEDS), the secure client/server computing environment (ASDEP), and Cockpit Avionics Upgrade (CAU). All IT resources identified for FSW are dedicated to these responsibilities. The JSC Space Shuttle Program Flight Software Investment is in the Operations phase of NASA Information Technology (IT) Capital Planning and Investment Control (CPIC) process, and this IT investment is managed as a component of the NASA project under NASA's NPG 7120 process.

Currently, the FSW is supporting the Operational Increments (OI's)-28, -29, and -30. OI-41, which provides the CAU with safety enhancements, is scheduled for release in August 2004.

10.1.5 JSC Space Shuttle Program Integration

Space Shuttle Program Program Integration (SSP PI) includes elements managed by the Space Shuttle Program Office at the Johnson Space Center (JSC) and conducted primarily by United Space Alliance, including payload integration into the Space Shuttle, systems integration of the flight hardware elements through all phases of flight, and configuration management of program hardware, software, and requirements. The information technology parts of SSP PI include such applications as Baseline Accounting and Reporting System, Mission Requirements control System, Automated Scheduling and Planning, Automated Mission & Payload Tracking System, Shuttle Drawing System, Program Compliance Assurance and Status System, Shuttle Integration Accounting Status System, Verification Information System, Work Authorizing Documentation System, Waivers/Exceptions, Operations and

Maintenance Requirements and Specifications Change Processing, Document Configuration Management System, Technical Document Management System 2, Shuttle Payload Integration and Cargo Evaluation System, Critical Math Model Database, Launch Management System. The major expenses are either sustaining or migrating mainframe projects to a web-based, client-server environment. This also includes the cost allocations for the office automation services supporting the employees of this function.

10.1.6 JSC Space Station Production Facility

This facility, separated into Development, Integration, and Production environments, provides tools for engineering analysis for International Space Station Program (ISSP) development and sustaining; for management of program manifests and on-orbit inventory, etc.; for access to and maintenance of critical Program data (including Station physical properties, drawings, etc.) required for NASA, Boeing and other Program Participants to meet their Program commitments. These tools are a combination of COTS and internally developed applications specifically to provide support to the ISSP. The JSC Space Station Production Facility Investment is in the Operations phase of NASA IT Capital Planning & Investment Control (CPIC) process, and this IT investment is managed as a component of the NASA project under NASA's NPG 7120 process.

10.1.7 JSC Space Station Training Facility

The benefits inherent in ISS operations are possible only by ensuring that the operators have the necessary knowledge and skills. The operators are the ISS crew and the flight controllers in the ground control centers. Assurance of prerequisite knowledge and skills prior to ISS mission operations is made possible by extensive training. ISS training is mandatory before and during flight. This investment is the Space Station Training Facility (SSTF). It consists of a set of simulators that provide application services in support of ISS training needs. Each simulator is designed to focus on specific types of training. The primary customers are the instructors, crew, and flight controllers. Other customers include the Mission Control Center test team and ISS procedure developers. The ISS Program Manager is the key stakeholder. The SSTF has three main simulators: Full Task Trainer (FTT), Part Task Trainer (PTT), and American Segment Trainer (AST).

10.1.8 KSC Ground Operations

Ground Operations is in the Operational phase of the NASA Capital Planning and Investment Control Process. Ground Operations are networks, tasks, and functions that are not covered in the Launch Control Systems and directly support Shuttle Processing at the Kennedy Space Center. This covers all platforms and LAN operational functions and associated maintenance and support of ADP hardware and software. This category also covers the O&M of the various Instrumentation systems such as the Ground Measurement System, Permanent Measuring System, Catenary Wire Lightning Instrumentation System, Lightning Induced Voltage Instrumentation System, the Shuttle Modal Inspection System, and others.

The FY04 information technology annual review/approval (Capital Planning and Investment Control process) for this investment was held September 26, 2003 by the Shuttle Program IT CPIC Review Board.

10.1.9 KSC Integrated Logistics

The Space Shuttle program plays a vital role in enabling NASA's vision and mission. This includes advancing human exploration and providing safe access to space in support of human operations in low-earth orbit. In order to maintain a viable human transportation capability that will operate and support NASA's launch requirements, specific program investments are required. NASA is revamping its approach to selecting and managing these investments to ensure Shuttle operability into the next decade and avoid future project overruns. These investments will be consistent with NASA's strategy of ensuring the Space Shuttle remains viable until a new transportation system is operational. These projects will provide revitalization of the infrastructure, and combat obsolescence of vehicle, ground systems, and facilities. The Integrated Logistics organization supports NASA's strategies for future IT initiatives while complying with consolidated IT standards. The Integrated Logistics organization maintains current Logistics systems as well as spares and provides repair support for the Operations Center for Shuttle Avionics Integration Laboratory (SAIL), Training Operations Center (TOC) and Integration and Program Requirements-Multi-facility. The Integrated Logistics organization provides spares/repairs for IT hardware and software supporting NASA Shuttle Logistics Depot (NSLD) Special Test Equipment and CAD systems that support manufacturing and repair activities.
The Integrated Logistics organization continues to support current and future process improvements and support the IT requirements for the migration of the Logistics systems to the enterprise Peoplesoft Tool. PeopleSoft Inventory - The first release of the PeopleSoft Inventory and Manufacturing system was completed in July 2002. The focus is on system improvements such as the streamlined demand process, inventory out-of-balance corrections, Shelf-Life Management, Contamination /Decontamination requests, ASRS Mini-loader interface. Peoplesoft is required to process the Space Shuttle at KSC. The Integrated Logistics function is in the operational phase. The Space Flight Operations Contract (SFOC) covers all Information Technology (IT) related activities including the design, development, implementation and maintenance of computer-related hardware and software systems as required to process the Space Shuttle at KSC. This includes Integrated Logistics which provides for repairs, spare parts, and warehousing for the Space Shuttle Orbiters, and associated Ground Support Equipment (GSE). The Integrated Logistic investment reduces lifecycle cost of replacement equipment. The requirements for lifecycle cost for replacement of Ground Support Equipment (GSE) is the only supported funding in the lifecycle cost of this GSE.The FY04 information technology annual review/approval (Capital Planning and Investment Control process) for this investment was held September 26, 2003 by the Shuttle Program IT CPIC Review Board.

10.1.10 KSC Launch Control System (LCS)

The Launch Control System (LCS) function is in the operational phase of the NASA Capital Planning and Investment Control (CPIC) process. The Launch Control System (LCS) is required at Kennedy Space Center to process and launch the Space Shuttle. It consists of Shuttle Data Center (SDC),

Checkout Control and Monitor Subsystem (CCMS) Operations, Record and Playback Subsystem (RPS), and Other Non-System Specific Systems (Other O&M). The Shuttle Data Center provides storage and recall of all shuttle processing and launch data. The CCMS is a custom design computer hardware and software system for processing and launching the Space Shuttle. The system currently operates with 100 consoles, 240 peripherals, 12 million lines of Launch Processing System (LPS) source code, and 1.6 million lines of executable Ground Operations Aerospace Language (GOAL) code. The Record and Playback Subsystem (RPS) primary function is to record unprocessed Shuttle on board instrumentation data during tests and launch countdowns. The FY04 information technology annual review/approval (Capital Planning and Investment Control process) for this investment was held September 26, 2003 by the Shuttle Program IT CPIC Review Board.

10.1.11 KSC Operational Television System Modernization

The Space Shuttle program plays a vital role in enabling NASA's vision and mission. This includes advancing human exploration and providing safe access to space in support of human operations in low-earth orbit. In order to maintain a viable human transportation capability that will operate and support NASA's launch requirements, specific program investments are required. NASA is revamping its approach to selecting and managing these investments to ensure Shuttle operability into the next decade and avoid future project overruns. These investments will be consistent with NASA's strategy of ensuring the Space Shuttle remains viable until a new transportation system is operational. These projects will provide revitalization of the infrastructure, and combat obsolescence of vehicle, ground systems, and facilities. The Operational Television System function is in the operational phase of the NASA Capital Planning and Investment Control (CPIC) process. OTV provides operational and safety situational awareness required by the KSC test team in support of Launch & Landing functions by being a second set of eyes or even being the only method of viewing hazardous or high energy activities in support of Shuttle Processing and Launch. OTV is funded and managed by the Shuttle Program. OTV allows us to meet strict safety of flight requirements. OTV is not a general-purpose television system. It is a closed network used for operations, launch and landing system.

10.1.12 KSC Shuttle Processing Support

The Shuttle Processing Support investment is in the Control phase of the NASA Capital Planning and Investment Control (CPIC) process. Kennedy Space Center (KSC) still uses a significant portion of converted Apollo infrastructure, facilities and equipment for Shuttle Processing. The Launch Site Equipment (LSE) budget helps maintain this aged infrastructure, facilities and equipment with a current replacement value (CRV) in excess of $3B. Space Flight Operations Contract (SFOC) and other contractors maintain current capability and replace equipment with similar equipment. The LSE’s budget funds the major refurbishment of ground equipment and provides new capabilities when required.
LSE projects typically involve redesigns driven by obsolescence problems or to correct problems necessary to "keep the doors open”. Only summary data, a brief project description and Part II are provided.

10.2 Multi-Program/Project IT

10.2.1 ARC Aerospace Technology Support System

Fiscal Year 2004 is the FINAL YEAR of this system. The ARC Aerospace Technology Support System provides Ames Research Center's Information Technology support of Aerospace Technology Enterprise programs. IT resources include computers from specialized, small desktop and instrument control computers to powerful, large supercomputers, as well as specialized networking hardware. Software includes commercial science and technology applications and tools, as well as ad hoc, custom-built programs and objects. Services include maintenance, system and network administration, operational support and software maintenance. These investments are in the operations phase of the NASA Capital Planning and Investment Control process and are managed as part of the supported NASA Aerospace Enterprise programs under the NASA Procedures and Guidance (NPG) 7120 program management process.

10.2.2 ARC High End Computing

The NASA Advanced Simulation (NAS) Program supports the scientific and modeling requirements of the entire agency. The NAS provides an integrated environment for simulation that includes high speed access to the cutting edge High-end Computing (HEC) platforms, assistance with application porting and scaling, storage, pre and post processing support, visualizations, training and on line and help desk support. The center provides a numerical simulation capability that allows NAS to initiate the most demanding projects in science and engineering while providing a capacity that insures that all the enterprises can pursue their highest priority projects with minimum interference. The program will enable factor of 10-100 advances in vehicle, earth, space and life sciences modeling.

10.2.3 GSFC - Earth Observing Sys Data Info Sys

The Earth Observing System (EOS) Data and Information System (EOSDIS) is a comprehensive distributed system designed to support NASA's EOS. EOSDIS archives, manages, and distributes Earth science data from NASA missions and provides spacecraft control and science data processing for the EOS missions. EOSDIS has been archiving and distributing pre-EOS data since 1994. Currently EOSDIS supports both the pre-EOS and EOS data. EOSDIS has been distributing Earth Science Enterprise (ESE) data to a broad user community, enabling research, applications, education and policy analysis. EOSDIS is now supporting Aura mission that was launched in July 2004. It is an essential component of NASA's Earth science program in order to ensure that the valuable data from its Earth observing satellites are captured, preserved and made available to the user community for scientific research and applications of national importance. A large community has now become accustomed to

data and information products from EOSDIS as evidenced by the number of users of EOSDIS (over 2.3 million accessing and over 280,000 ordering data in FY 2003 and similar statistics expected in FY 2004).

10.2.4 GSFC - NASA Center for Computational Sciences

The NASA Center for Computational Sciences (NCCS) supports primarily scientific modeling in the Earth sciences. The NCCS' high performance computer systems, mass data storage systems, and high performance networks serve about 1,000 users. NCCS is an ongoing operational data center, but most of NCCS funds are classified as DME (planning and acquisition) rather than Steady State. This is primarily because the purchase prices of new systems, which are replenished every few years, are much greater than system maintenance costs. Consequently, the NCCS investment is Mixed life cycle. The overall investment has been reviewed on August 13, 2004 by the Program Management Council (PMC) and the NASA headquarters OCIO as part of the NASA CPIC control processes. The investment is meeting its value objectives and a decision to continue funding has been made.

(Most hardware assets have an approximate three year lifecycle. NCCS constantly refreshes and updates its suite of hardware, software, mass storage, and network infrastructure, consistent with resource availability.)

NCCS supports scientific modeling research in the Earth, space, life, and microgravity sciences. The NCCS is a key resource in the effort to restore international leadership to the U.S. program in weather and climate prediction to increase understanding of Earth's climate system, natural and human influences on climate, and consequences for life on Earth. NCCS system applications will lead to greater understanding of the Earth system, the solar system, and the universe through computational use of space-borne observations and computer modeling. The three largest Earth Science projects that the NCCS supports are the Data Assimilation Office (DAO), the NASA Seasonal to Interannual Prediction Project (NSIPP) (Note: DAO and NSIPP merged as the GMAO - Global Modeling and Assimilation Office), and the Computational Technologies (CT) Project of the Earth Science Technology Office (ESTO). The Goddard Institute of Space Studies (GISS) is also a major NCCS user.

10.2.5 GSFC - Space and Ground Network IT Support

The Space and Ground Network IT Support is in the operation phase of the NASA IT Capital Planning Investment Control Process. The National Aeronautics and Space Administration Space and Ground Networks, in operation since the 1980s, provide mission communications for multiple Space Network and Ground Network tracking stations. These existing communication facilities are operated and maintained for pre-launch checkout, launch and landing, and on-orbit tracking, telemetry data acquisition, and command services for crewed and robotic low-Earth orbiting spacecraft, and suborbital rockets and balloons. The Space Network includes nine geosynchronous satellites, and is currently supported through non-NASA reimbursable funding.

Space Network - The Tracking and Data Relay Satellites (TDRS) in geosynchronous orbit are situated in Earth orbit such that they can provide continual, global coverage. There are several services provided by the Space Network to our customers. They include telecommunications, tracking and spacecraft clock calibration, testing, and analysis. The Space Network is operated 24x7, 365 days per year. This is driven by the need to control and operate the TDRS constellation and the fact that our customers request support at all hours. Included in this list of customers are the International Space Station and the Space Shuttle, both of whom schedule continuous coverage from the network.

The Ground Network (GN) - provides launch support, orbiting spacecraft support, and sounding rocket and atmospheric balloon mission support. The GN also supports critical Space Shuttle launch, emergency communications, and landing activities. The GN provides for the implementation, maintenance, and operation of the tracking and communications facilities necessary to fulfill program goals for flight projects in the NASA mission set. Missions supported also include NASA inter-agency collaborative programs, commercial enterprises, and other national, international, and commercial enterprises on a reimbursable basis.

10.2.6 JSC Flight Operations

FO, as the contractual arm of the JSC Mission Operations Directorate (MOD), directly supports NASA's goal of flying missions safely with mission objectives achieved by providing the products, services and facilities used to prepare and support such missions. The major functions for flight operations include management and integration, mission operations, vehicle operations, flight systems operations, flight control, flight crew and flight controller training functions, flight design & dynamic operations, preflight and flight control team functions, flight planning, payloads and assembly operations, crew procedures, and operational readiness for the Shuttle Program missions. Primary training facilities include the Shuttle Mission Training Facility, Flight Operations Trainers and the Space Station Training Facility. Shuttle onboard flight software is built and certified in the FO Software Production Facility. The JSC Flight Operations Investment is in the Control process of NASA Information Technology (IT) Capital Planning and Investment Control (CPIC) process, and this IT investment is managed as a component of the NASA project under NASA's NPG 7120 process

10.2.7 JSC Integrated Planning System

The Integrated Planning Systems (IPS) provides the ground system computational capabilities which the Space Shuttle and the International Space Station (ISS) mission planners and flight controllers use for pre-mission planning, shuttle profile design and analysis including powered flight guidance and control software verification, post-mission analysis, and near real-time mission support. IPS is comprised of an Open Systems standards based data processing platform on which applications are hosted. IPS is a distributed system with Workstations (WS's) connected to computational and data servers. IPS provides a standard set of mission planning applications for producing the integrated mission activity timeline, and utilizes a central data management system to store and distribute products.

The JSC Integrated Planning System investment is in the Operations phase of NASA IT CPIC process, and this IT investment is managed as a component of the NASA project under NASA's NPG 7120 process.

10.2.8 JSC Mission Control Center

The JSC Mission Control Center (MCC) directly supports NASA's goals by providing command and control capabilities for safe mission operations of the International Space Station and Space Shuttle. The MCC provides common infrastructure architecture of distributed COTS, Unix workstations, servers, networks, voice systems, data storage and retrieval, and platform software to support multiple vehicles. The general-purpose software architecture provides a level of software infrastructure independent of program and vehicle. The support functions include flight reconfiguration product generation, mission planning, command and control flight operations, flight controller & crew training, & software development.
The JSC Mission Control Center is in the Operations phase of NASA IT CPIC process, and this IT investment is managed as a component of the NASA project under NASA's NPG 7120 process.

10.2.9 MSFC Payload Operations and Integration Center

The Payload Operations Integration Center (POIC), located within the Huntsville Operations Support Center (HOSC) at Marshall Space Flight Center, is the primary single NASA ground system responsible for integrated operational payload flight control and planning for the International Space Station program supporting the Biological and Physical Research and Space Flight Enterprises. The POIC is in the Operations phase of the NASA IT Capital Planning and Investment Control (CPIC) process, and this IT investment is managed as a component of the International Space Station Program under NASA's NPG 7120 process.
The POIC provides payload telemetry processing, command uplink, and planning capabilities for a large number of local POIC Cadre flight controllers and remote ISS payload users/customers and other facilities located throughout the world. Additionally, the Telescience Resource Kit (TReK) software is provided to remote customers in order to simplify interaction with the ISS vehicle and the POIC information systems. POIC software is provided to other NASA centers and customers including: the Kennedy Space Center (KSC) (which utilizes a copy of the POIC software within the Payload Test and Checkout System (PTCS)); and a multitude of ISS payload customers using TReK software. The POIC integrates/controls: ISS payload flight operations, simulation, and mission-test preparation activities. ISS core systems and payload telemetry data is received, processed, stored, retrieved, displayed, and distributed to local and remote payload users/controllers. The POIC provides the capability to receive commands from local and remote users, analyze the uplinks for authenticity/authorization, performs required hazardous command checks, transmit the commands to the ISS (via the Mission Control Center-Houston (MCC-H)), and log all the command system activities for analysis/ troubleshooting purposes. The POIC provides the capability to uplink/downlink files to/from the ISS and store/retrieve mission-related documents, procedures, and files. The POIC also provides the integration point for planning all ISS payload operations by: assessing/integrating user operational requirements, analyzing available on-orbit and ground resources, and generating detailed execution timelines scheduling the user operations in a safe and efficient manner.

11 Gap and Flashpoint Analysis

The Center General Purpose Architecture submissions, especially identified Flashpoints, and the Mission and Mission Support Architecture submissions were examined to determine if any key patterns could be discerned. There were (nine) patterns that were identified. These patterns, as well as perhaps others, will be studied by the Enterprise Architecture Team. (Business cases and initiatives will flow from the ongoing Architecture and Investment processes as appropriate.) The patterns identified are:

11.1 Mass Storage

NASA generates enormous amounts of data in all its key processes. This is true especially in the science and engineering functions, where the requirements range from enormous amounts of Earth Science, Space Science, and Human Exploration operational data through scientific modeling and engineering design functions which may require special processing by advanced supercomputers or graphics processors. The General Purpose functions also require a degree of Mass Storage management for such mundane purposes as automated system backup and recovery capabilities as well as organization-wide document management, retrieval and archive. Although specific requirements vary across the Centers to some degree, all Centers have significant requirements to support these capabilities, but either don't do it at an infrastructure level or do so in a wide variety of disparate configurations. Several Centers are known to have some level of institutional distributed and/or centralized hierarchical Mass Storage capability, in some cases as part of supercomputing facilities, and several Centers included some concerns about Mass Storage in their Flashpoints. There have been periodic Mass Storage working groups over past years. There is a potential that a Mass Storage initiative could significantly improve performance and reduce costs, and the Enterprise Architecture Team will be requested to evaluate this potential and make a recommendation.

11.2 Print Management

Managing hard copy print of IT output is a common requirement. At the simplest level, the requirement can simply be met by providing every end-user with an attached printer. However, this solution does not address special print requirements best met by specialized devices and ignores both the financial cost of providing devices as well as hidden costs involved with support and maintenance. Several Centers have implemented some form of organization-wide approach to print management and there has been a NASA wide working group which has provided a level of common service and contracting vehicle for specialized printing requirements. However, some Centers provided Flashpoint comments related to a need for an organizational solution. There is a potential that a Print Management initiative could significantly improve performance and reduce costs, and the Enterprise Architecture Team will be requested to evaluate this potential and make a recommendation.

11.3 Mobile/Wireless Standards

User mobility and a requirement for Center and Agency level solutions to accommodate a variety of portable access modes has been raised for some period of time already. In fact, several Centers have either begun pilot implementations of wireless networks or have even begun to provide limited services in some constrained areas. Although there are clear potential benefits to both users and service providers, major issues remain in terms of secure and reliable service. In large measure, the technologies are sufficiently mature for NASA to provision a large set of services for mobile users via wireless devices and networks. However, common implementation guidelines, common security deployments, and common NASA standards and architectural guidelines are required. The Enterprise Architecture Team will be requested to evaluate this potential and make a recommendation.

11.4 License and Application Serving

Much of the common software in use in the General Purpose environment is provided as an element of a software "standard load". In addition, much additional special purpose software is available either as a catalog selection on an ODIN contract or through some mass buy vehicle such as the Scientific and Engineering Workstation Procurement (SEWP) III contract. A number of software products NASA uses, whether part of these contracts or purchased independently, have multi user application or license sharing modes of access. Where this is available and it meets functional requirements, license serving or sharing can sometimes offer significant acquisition and support costs. Some Centers have used this mode of service access, but the availability is not uniform nor uniformly managed. There is a potential that a License and Application Serving initiative could significantly improve performance and reduce costs, and the Enterprise Architecture Team will be requested to evaluate this potential and make a recommendation.

11.5 Open Source and Open Source Office Automation

In the mid and late 90's NASA established and evolved the NASA Office Automation Minimum standards suite (NASA Standard 2804). Initially, the standard established Microsoft Word, PowerPoint, and Excel document formats as interchange standards, but allowed alternative software packages to be used if they complied with the interchange standard. As the desktop service was outsourced, the costs of maintaining multiple products in the environment grew, and interoperability issues among competing products continued to surface, a slow migration to Microsoft applications took place. The standards provided NASA with a very robust interoperable environment. In parallel, however, the Open Source movement has been growing as has been the maturity of open source application availability. This movement has been tracked by the standards group in NASA. It appears that maturity may be reaching a critical stage wherein Open Standards are sufficiently robust and mature and the costs sufficiently reduced that a migration to a non-proprietary open source Office Automation environment could significantly improve performance and reduce costs. The Enterprise Architecture Team will be requested to evaluate this potential and make a recommendation.

11.6 Voice, Video and Data Convergence

The voice, video, and data communications technologies are in an early stage of convergence and several Centers have raised the convergence as a technical Flashpoint to monitor. NASA requested a study of Voice/Video over IP by the GAO (?). The results of the study indicated that video and data communications over IP appeared to be more rapidly maturing, but that voice over IP would mature at a slightly slower pace and that NASA would be best served by not yet undertaking any significant initiatives in this area. The Enterprise Architecture Team will be requested to monitor this potential and make a recommendation at the appropriate time.

11.7 XML Training

It is clear that XML is a standard providing considerable benefits. However, many of the IT professionals in NASA have not had detailed XML training. There is a potential that an XML training and awareness initiative could significantly improve performance and reduce costs, and the Enterprise Architecture Team will be requested to evaluate this potential and make a recommendation.

12 Summary

NASA has made strong progress in developing and refining the Agency's Enterprise Architecture over the past year. The Agency Enterprise Architecture team has been formed and has compiled this current "As is" architecture. The team is continuing refinement of the "To-be" architecture, which is described in Volume 5.

NASA has adopted the major elements of the Federal Enterprise Architecture and is supporting the development of the Federal Enterprise Architecture. NASA will continue to engage with the CIO Council and the federal Architecture and Infrastructure Committee (AIC) and its' subcommittees. As a part of the development of this document and our business cases for the OMB budget submissions we mapped all of our general purpose and a representative subset of our mission specific IT investment to the Federal Enterprise Architecture reference models. We have extended the reference models to capture the unique elements of NASA science and research and technology missions.

NASA has defined a set of core Architectural Portfolio Components for the Infrastructure, Office Automation and Telecommunication elements of our general-purpose architecture and is using the common definition to focus and support our EA efforts. The set of portfolio components is being extended to include the elements of the Multi-Program/Project IT investments.

The NASA Enterprise Architecture is cohesive strategy for managing the Agency's IT infrastructure as an integrated architecture that support the One NASA strategy and the Agency's strategic plan, core missions and implementing strategies. The Enterprise Architecture provides a customer focus to the provisioning of common IT services across NASA. The Enterprise Architecture will evolve as required to support enable effective and efficient integration with Federal e-Gov applications and the President's Management Agenda.

Starting with Version 3.0 scheduled for release in September of 2004, the Enterprise Architecture will transition to a semi-annual release schedule. The document release schedule will be reviewed on a semi-annual basis and updated as required.